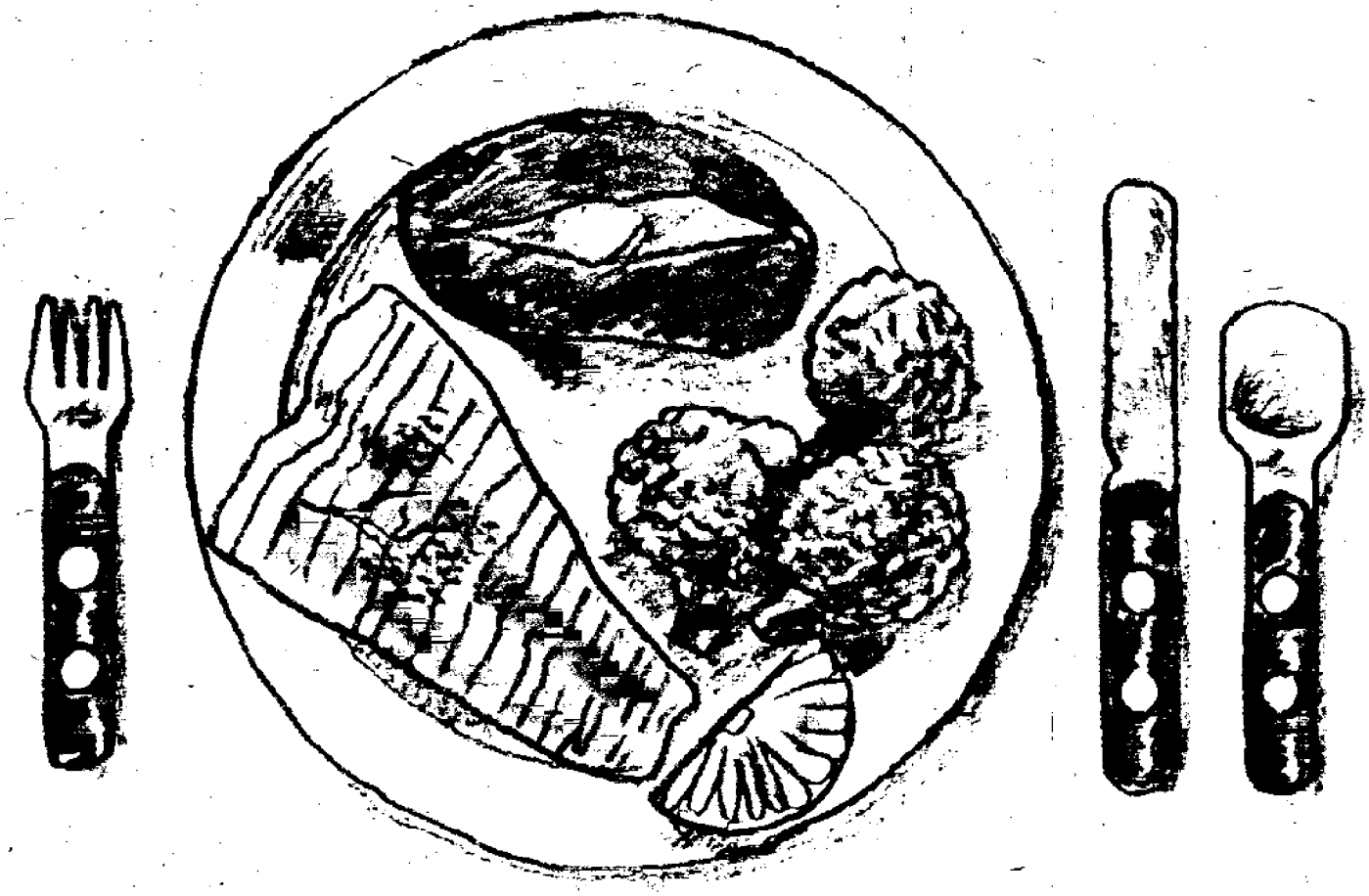
EATING GREAT LAKES FISH

Michigan Sea Grant Extension

Michigan Sea Grant College Program



Extension Bulletin E-2028 • Michigan Sea Grant Publication MICHU-SG-94-502 • Revised January 1995

Whether it's broiled lake trout, smoked salmon, deep-fried perch, baked whitefish or pan-fried walleye, people like to eat Great Lakes fish. The catch can be made by a sport angler or by a commercial fishing operation, from a boat in the middle of the lake or from a dock in a major metropolitan area. Whatever the method, a Great Lakes fish is almost surely on its way to someone's dinner table.

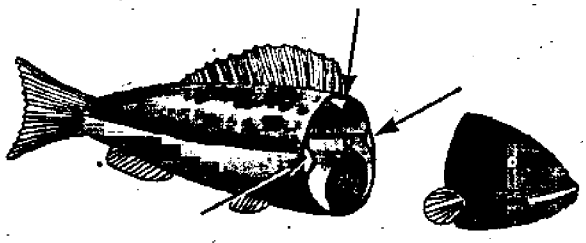
Eating fish regularly can decrease your chances of heart disease and is healthy for you in other ways. Despite this and the appeal of Great Lakes fish, the question in many peoples' minds is, "Is this fish safe to eat?" This is usually prompted by concern and confusion about contaminants. For example, a report one week may show that a new type of contaminant has been identified in fish, while another report a week later indicates that fish is the best health food available. To clear up this confusion, people need to learn about the nature of contaminants, the amounts of such substances in the Great Lakes, how they get into fish, and the potential health effects of eating the fish.

The topic of contaminants is quite complex. This bulletin provides valuable information about eating Great Lakes fish. It will help Great Lakes anglers continue to enjoy the health benefits from fish consumption while greatly reducing any potential health risks from contaminants. Given this information, it ultimately is up to individuals to decide about the safety of the fish that they consume.

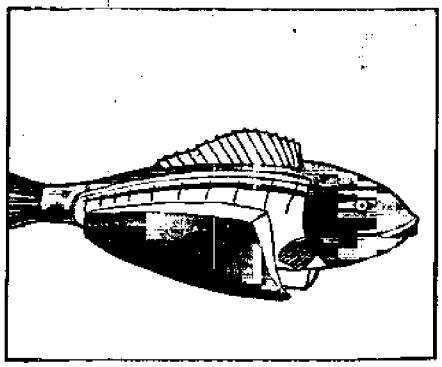
What are contaminants and where do they come from?

Both naturally occurring and synthetically produced toxic chemicals are used in industry, commerce, agriculture and the home. Unless raw materials, finished products, manufacturing by-products, and wastes are properly handled, these chemical substances can become environmental contaminants. Contaminants have the potential to disrupt ecosystems and contaminate fish habitats.

Because many chemicals evaporate into the atmosphere, they can be carried to the Great Lakes from sources thousands of miles away. These chemicals enter the lakes through rainfall or may fall as dry particles directly from the atmosphere after being released from factories, power plants, farms, incinerators, and other sources. Atmospheric inputs are believed to be a major route of toxic substances entering the Great Lakes today. As much as 90 percent of certain toxic substances entering Lake Superior are deposited from the atmosphere. Even in the industrialized basin of Lake Michigan, airborne contaminants contribute 25 percent of the input of PCBs. In addition, pesticides, herbicides, fungicides and related compounds can dissolve in rain and irrigation water or attach to soil particles and run off into streams, rivers and lakes, including the Great Lakes.



Low level organic contaminants tend to accumulate in fatty parts of fish (arrows) and should be removed



The use and disposal of consumer products, such as household cleaners, paints, batteries, pharmaceuticals, varnishes and automobile products that contain toxic or hazardous materials may also contribute to Great Lakes contaminant levels. An estimated 30,000 synthetic organic chemicals are produced commercially in the United States. More than 700 hazardous chemicals are generated in quantities ranging from thousands to billions of pounds per year, depending on the chemical. Approximately 400 hazardous chemicals have been detected within the Great Lakes ecosystem in parts per million (ppm) or lower. While a ppm is a very small amount, some chemicals can cause toxicity even in minute doses. The "part per" terminology is detailed later.

What are the major contaminants in the Great Lakes?

While the use of DDT, PCBs and the more serious environmental contaminants has been banned in the United States, several are still manufactured and utilized in the U.S. and other countries. As a result, they continue to enter the Great Lakes, especially through the atmosphere. Chemicals of special concern in Great Lakes fish are halogenated hydrocarbons and heavy metals.

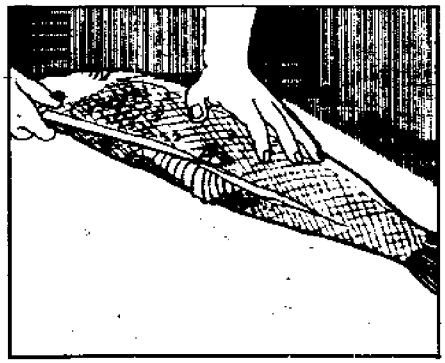
Halogenated hydrocarbons include PCBs, DDT, chlordane, toxaphene and dieldrin. While all these chemicals are banned, they are persistent, meaning they do not degrade quickly or easily in the environment. Halogenated hydrocarbons accumulate in the fatty tissues of aquatic organisms, including fish, and are only slowly excreted from the body. PCBs and DDT have declined 90 percent in Great Lakes fish since the ban. Even though contaminant levels have dropped considerably, the presence of certain contaminants continues to be a problem in some fish.

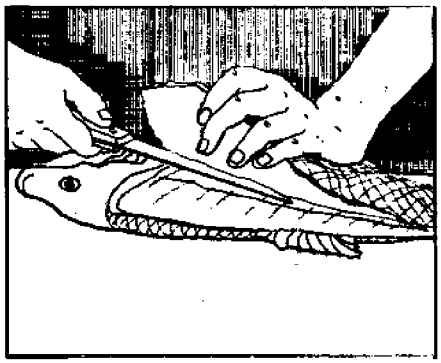
Heavy metals, originating from both natural and manmade sources, are also a concern in the Great Lakes basin, as well as many other areas of the world. Metals, particularly mercury, may weather or degrade from soils and rock. Evidence suggests that about half of the mercury in Michigan's inland lakes enters from natural sources. Heavy metal contamination problems linked with industrial output have diminished since 1970 due to improved industrial practices and more effective government regulations. However, mercury remains a contaminant of concern in some Great Lakes fish.

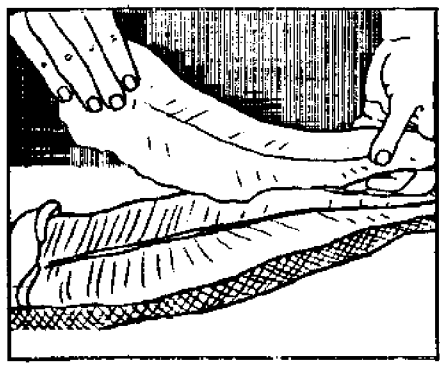
How do contaminants get into fish?

Chemicals that enter the aquatic ecosystem are sometimes changed by chemical, biological and/or physical processes. Halogenated hydrocarbons resist such changes, but the mercury can be biologically altered into methylmercury. Halogenated hydrocarbons and methylmercury may be taken in and stored by fish (bioaccumulated).

Carefully fillet the fish with a sharp, long-bladed knife.







Fish bioaccumulate toxic compounds directly from the water through their gills and from the food they eat. Therefore, the concentrations of contaminants in fish are directly related to the amount of contamination in that aquatic ecosystem. As each higher life form in the food chain preys on contaminated lower life forms, the quantity of contaminants in its own system is increased or magnified. Contaminant levels in fish can be as much as a million times greater than in the water in which they live because of this bioaccumulation and biomagnification.

Where chemicals are stored in fish makes an important difference.

Mercury is distributed throughout the fish, particularly in muscle tissue (the part you eat) and in the organs, while halogenated hydrocarbons accumulate to a higher degree in the fat and skin. Both are likely to be bioaccumulated by aquatic organisms.

Still, contaminant levels in Great Lakes fish are extremely small. Levels range from a part per trillion (ppt) to a part per million (ppm). "Part per" terminology compares the concentration of one material in a larger amount of another material. To understand how small a part per billion (ppb) is, consider a pinch of salt in 10 tons of potato chips to be a part per billion. Since fish can contain much higher levels of PCBs than air or drinking water, most of the PCBs people consume will come from fish and will depend on the amount of fish eaten and how contaminated it is.

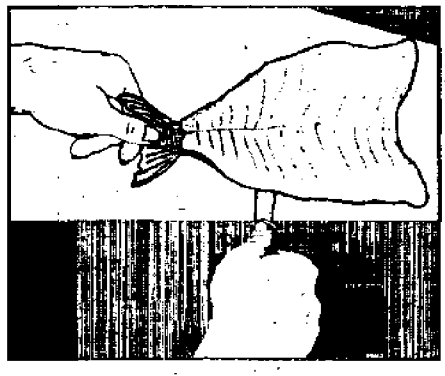
The concentrations of contaminants in fish vary greatly among and within species primarily because of differences in their size, age, habitats, behavior and amount of body fat. In addition, the amount of pollution in an area influences the level of contaminants within a species. Pollutants vary in each of the Great Lakes and in the organisms living there. Similar problems exist in other areas of the United States and the world.

Skin the fillets, holding the tail section firmly. Run the blade between the skin and the meat along the table surface

How can you tell what concentrations of contaminants are in a fish?

It is impossible to tell by looking at a fish whether or not it contains toxic substances. This can only be determined by using sophisticated equipment to test them. However, you can use the following to assess whether or not a fish is likely to have levels of concern: species, size (age) and location of the catch.

The Michigan Department of Public Health (MDPH) issues annual advisories for eating fish caught by anglers in Michigan. These are based on chemical contaminant analyses performed by the MDPH and are revised each year as more fish are collected and tested. The current Fish Consumption Advisory, published in the Michigan Fishing Guide and distributed with fishing licenses, describes the locations, species and size of sport fish caught where consumption precautions should be followed. The MDPH advisory applies to inland



lakes and streams as well as the Great Lakes waters of Michigan. Therefore, it is important to read and consider this information carefully when evaluating the quantity, type, size and location of fish to be consumed.

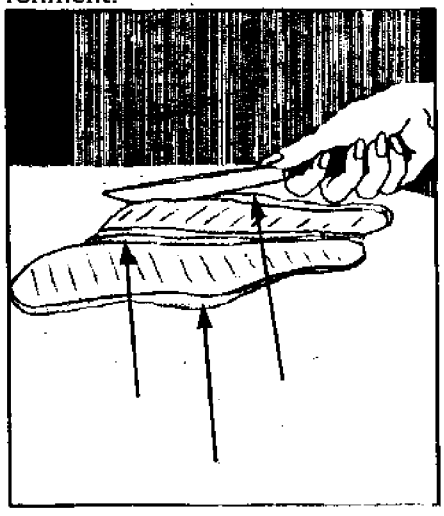
Fish caught commercially for interstate sale are regulated by the U.S. Food and Drug Administration (FDA). Maximum permissible levels are set for each contaminant, based on a risk assessment and a number of toxicological, social, economic and political considerations of a national scope. Federal and state agencies combine efforts to sample fish and enforce these standards. The Michigan Department of Agriculture monitors and regulates commercially caught fish.

How can contaminants in Great Lakes fish affect human health?

The health effects of contaminated fish are hard to predict because they depend on four factors, each of which is difficult to measure:

- the toxicity of the chemical,
- how often it was consumed,
- the amount ingested over a lifetime,
- the characteristics of the consumer—i.e., diet, state of health, lifestyle, age, and genetic make-up.

The most important factor is the amount ingested over a lifetime. The amounts of chemicals found in Great Lakes fish are not known to cause immediate sickness. However, with long-term consumption, the chemicals can collect in the body and people are concerned that the substances may affect their health or the health of their children. All chemicals can be toxic at high enough doses, and the larger the dose of contaminants, the greater the chance of toxic effects. Therefore, people who eat fish that contain a greater amount of contaminants, or eat contaminated fish often may be at risk. Occasional consumption of Great Lakes fish should not be of concern. Research shows that a majority of Great Lakes fish have contaminant levels below that required by the Federal Drug Administration (FDA), and contaminant levels continue to decrease in the environment.



To evaluate contaminants found in fish for fish consumption advisories, scientists use risk assessments. Risk assessment is a complex, scientific process that evaluates the possible adverse human health effects caused by a substance, activity, lifestyle, or natural phenomenon. It describes what is likely to happen to humans who may be exposed. A risk assessment can be made when information is available on the toxicity of the chemical and the levels of exposure.

Certain groups of people are at greater potential risk than others if they are exposed to contaminants in fish. Pregnant women, nursing mothers, and women who may have children are examples. They are at risk primarily for their offspring. The unborn fetus or newborn child is very sensitive to chemicals, especially during the early period of development, so even low exposures may be harmful. A second group at risk is children under age 16. Normal growth and maturation could be affected by certain chemical exposures. Special precautions are recommended for these groups.

Trim fat along top center and edges of the fillet.

TRIMMING AND COOKING REDUCE CONTAMINANTS

In 1993, researchers at Michigan State University and the Michigan Department of Public Health released the results of a study on contaminants in cooked Great Lakes fish — the most comprehensive study of its kind. Five species — chinook salmon, carp, lake trout (including ciscowet), walleye and white bass — were analyzed to determine the degree of exposure to contaminants a person might receive from eating the fish. Each of these commonly caught species was chosen to represent a wide range of contaminant exposures from a variety of waters in the Great Lakes.

The results showed that trimming and cooking could reduce contaminants in fish by as much as 81% in some cases. Furthermore, the researchers found that only two of the 227 skin-on boneless filets analyzed had amounts exceeding 1994 FDA action levels for any of the 13 contaminants studied. The vast majority of the fish studied had contaminant concentrations below the current level of concern even before they were processed.

The trimming and cooking contaminant reduction results reinforce the Michigan Department of Public Health's advice on fileting and trimming. As shown in the accompanying graph, trimming alone reduced PCB levels by an average of approximately 46% in chinook, carp and lake trout. Cooking further reduced the remaining contaminant levels, bringing the average reduction in these three species to 68%.

Scoring the fish resulted in an additional decrease in contaminants. Scoring — or making shallow cuts in the fish flesh — increases the surface area of the fish and decreases the fat in the flesh when cooked. An additional 5-10 percent of contaminants was lost in fish that were scored.

Commonly used cooking methods for each species of fish were evaluated in the study. These included baking, charbroiling, charbroiling of scored fillets, deep fat frying, pan frying, salt boiling, smoking and canning. While few significant differences in contaminant reduction levels were found between cooking methods, losses from smoked lake trout were consistently high. Smoking proved so effective in reducing contaminants that the smoked lake trout did not differ significantly from the trimmed, skin-off lake trout cooked by other methods.

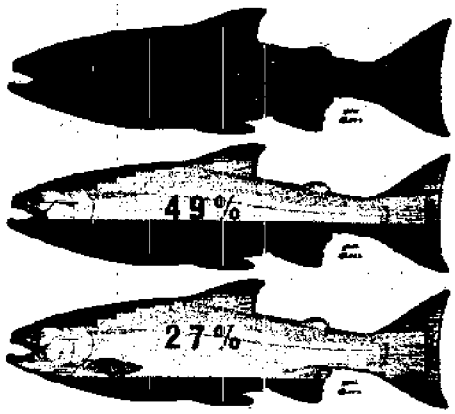
Each of the fish studied represented sizes anglers would normally catch, based on 1990 DNR data. Sample collection dates corresponded to typical sportfishing activity for each species.

The size information, the lakes where each of the three species were collected and the PCB reduction percentages for chinook, carp and lake trout are listed here (as shown in the graph). Reduction data for PCBs are used because most people are familiar with this contaminant. Also PCBs cause the greatest health concerns.

- Ten pound chinook from Lakes Michigan and Huron showed a 73% reduction,
- Three to four pound carp from Lakes Erie and Huron showed an 81% reduction,
- Three to seven pound lake trout from Lakes Michigan, Huron and Superior showed a reduction of 51%.

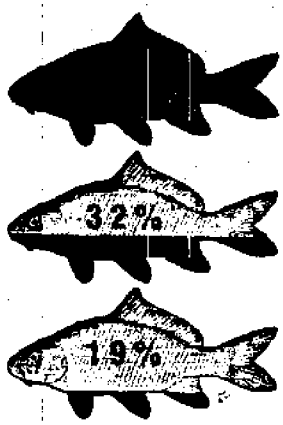
PCB Reduction in Three Typical Great Lakes Species after Preparing and Cooking Properly

Chinook



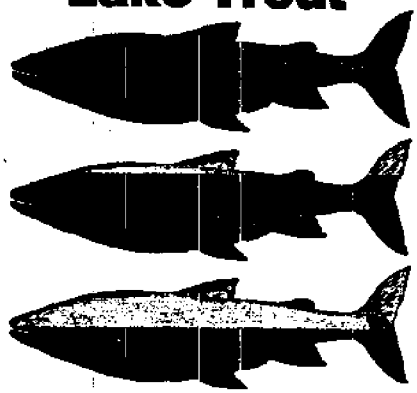
Total Reduction: 73%

Carp



Total Reduction: 81%

Lake Trout



Total Reduction: 51%

Average Total Reduction—Three Species: 68%

It is not possible to determine the exact level of risk for each person who eats contaminated fish, but experiments on laboratory animals indicate that levels do exist at which toxic effects on humans may possibly occur. These experiments have been one basis for setting maximum permissible contaminant levels in fish. The permissible amounts are not an exact borderline between safe and unsafe levels, as data from experiments on lab animals cannot always applied to humans. Instead they are designed to provide a substantial margin of safety.

Overall, the likelihood of adverse health effects from eating Great Lakes fish is very small. Many people believe that the wholesomeness and food value of the fish outweighs the minimal risk involved, especially when compared with exposure to contaminants from other sources, such as tobacco. However, in view of the continuing uncertainties in assessing toxicity to humans, it is important to limit exposure whenever possible. Suggestions on reducing exposure to contaminants in Great Lakes fish can be found on pages 2-7 of this publication. Although the likelihood of adverse health effects appears to be minimal, risk is highest in those regions that are most polluted, in those people who consume the largest quantity of fish on a regular basis, and in especially sensitive groups.

What precautions can people take to reduce exposure to contaminants in Great Lakes fish?

Those who enjoy catching and eating Great Lakes fish can follow these suggestions to decrease their exposure to contaminants.

1. Check the Michigan Department of Public Health advisory for consumption advice for fish from inland lakes and streams, as well as the Great Lakes. Note the bodies of water that are contaminated, which fish should not be eaten at all, and where limited consumption is recommended.
2. Avoid eating fatty species and older, larger fish frequently because they accumulate the highest concentration of organic contaminants. Leaner species, and younger, smaller fish, such as pan fish, generally are less contaminated and, therefore, represent less of an exposure risk.
3. Skinning, trimming and filleting freshly caught fatty fish to remove fatty portions can reduce contaminants by 46-64 percent, according to a study conducted in the early 1990s. Trimming the top back strip, lateral lines and belly flaps is particularly important because this greatly reduces the levels of halogenated hydrocarbons like PCBs (see diagram). However, heavy metals such as mercury are not reduced by these methods.
4. An average of one-third of any of the pesticides and total PCBs can be lost due to cooking and processing, regardless of the type of cooking method used. Fish cooking methods include baking, smoking, charbroiling, salt boiling, deep fat frying, pan frying or canning. As mentioned, the majority of Great Lakes fish have levels below FDA requirements even before cooking and processing.

For more information, contact the district Extension Sea Grant agent nearest you through the Michigan State University Extension office (listed in the white pages of the telephone directory under county government).

Issued in furtherance of MSU Extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gail L. Imig, extension director, Michigan State University, East Lansing, MI 48824-1039.

The Michigan Sea Grant College Program is a cooperative effort of Michigan State University and the University of Michigan in Great Lakes research, education and extension.

Produced by Outreach Communications.

ACKNOWLEDGEMENTS —

Several people contributed significantly to the development of this publication, including Frank M. D'Itri, Institute of Water Research, Michigan State University (MSU); Niles R. Kevern, Department of Fisheries and Wildlife, MSU, and Michigan Sea Grant College Program, MSU and the University of Michigan; Michael A. Kamrin, Center for Environmental Toxicology, MSU; Matthew I. Zabik, Pesticide Research Center, MSU; Mary Zabik and Alden M. Booren, Department of Food Science and Human Nutrition, MSU; Charles Pistis, Ronald E. Kinnunen, Carol Y. Swinehart and Amy E. Nevala, Michigan Sea Grant Extension.

Special thanks to John L. Hesse and James W. Bedford, Michigan Department of Public Health; Edward C. Heffron and Jerry Wotalla, Michigan Department of Agriculture; and Chris Wood and Asa Wright, Michigan Department of Natural Resources for their review and comments.

Other Extension Publications That May Interest You

VT044 The Life of the Lakes: The Great Lakes Fishery (Video)	$25.00
E 2440 The Life of the Lakes: A Guide to the Great Lakes Fishery	7.50
E 2441 The Life of the Lakes: A Guide to Great Lakes Fishery Educational Materials	5.00
E 2442 The Life of the Lakes: Lake Superior (poster)	1.50
E 2443 The Life of the Lakes: Lake Michigan (poster)	1.50
E 2444 The Life of the Lakes: Lake Huron (poster)	1.50
E 2445 The Life of the Lakes: Lake Erie (poster)	1.50
E 2446 The Life of the Lakes: Lake Ontario (poster)	1.50
E 2447 The Life of the Lakes: Great Lakes Basin (poster)	1.50
E 2475 The Life of the Lakes poster package (all 6 posters listed above)	7.50
E 2476 The Life of the Lakes complete package (includes all above items)	40.00
NCR 498 Freshwater Fish Preservation	1.00
4-H 1522 Great Lakes Fishes 4-H Fact Sheets	3.85
E1902 A Field Guide to Valuable Underwater Aquatic Plants of the Great Lakes	3.50

You may obtain these materials through your county's MSU Extension office or from the MSU bulletin office by writing to:

MSU Bulletin Office
10B Agriculture Hall
East Lansing, MI 48824-1039

Please enclose payment with all orders under $100. Canadian purchases must be made in U.S. dollars, with 15% added for postage and handling. Make checks payable to Michigan State University

Major revision 1:95-20M-TCM-FP-Price 35 cents, single copy free to Michigan residents.
File 23.214 (Fisheries)