How to enjoy fish safely

Facts about fish and nutrition

Autumn Thanksgiving

The roses
Enflamed the meadows
With whites and scarlets.
The robins
Filled the summer days
With their songs.
The whitefish
Flushed their silvered tails
In lakes and streams.

The corn
Waxed firm and tall
In sun and rain.
The deer
Grew sleek and fat
Upon the grasses.

Our stores are full
Our weapons are worn
Our spirits are glad
Gitche Manito has been kind.

—Excerpted from Ojibway Heritage, by Enniel Jobston

Introduction

For centuries the Great Lakes basin has supplied the Ojibwe people with abundant sources of food. Today, wild fish, game and plants continue to be important sources of nutrition for the Ojibwe. However, today tribal members must be alert to the potential of contamination in wild food sources, such as fish.

The Great Lakes Indian Fish & Wildlife Commission (GLIFWC) has prepared this supplement in an effort to support tribal members’ efforts to continue their traditional harvesting practices, promote traditional diets as a means of improving tribal members’ health conditions, and protect the health and safety of reservation communities. The following articles cover areas including:

- Making choices to reduce health risks from chemical contaminants found in fish;
- Health benefits of eating fish;
- GLIFWC’s fish sampling and testing programs for inland waters and Lake Superior;
- Cooperative implementation of new federal seafood safety regulations through cooperative training and partnership agreements between tribes and the U.S. Food and Drug Administration (FDA), and;
- Purchase locations for Lake Superior fish.

Making choices to reduce your risk

Fish provide a low-fat, high protein source of food that is known to provide health benefits. The challenge is to make decisions that enable you to obtain the health benefits of eating fish while minimizing the health risks to you and your family. To accomplish this, it is important to consider these important points:

- Contaminants in fish pose different risks for different ages of people. Special care needs to be taken by women intending to have children, pregnant women, breastfeeding mothers, and children under 15 years of age.
- Contaminant levels in fish vary by location. Choose lakes that are known to have fish with lower levels of contaminants.

Fresh from Lake Superior, a lake trout is hauled onto the ice by a Red Cliff commercial fisherman. Fresh fish is good eating and good for you. Two ounces monthly of lake trout each month provides 6 grams of omega-3 fatty acids. Studies have shown an average intake of 5.5 grams of omega-3 fatty acids per month reduced the risk of coronary heart disease by 50 percent. (Photo by Amoone.)

- Contaminant levels vary by fish species. Choose fish that don’t eat other fish, because their contaminant levels are often higher.
- Contaminant levels in fish vary by size. Choose smaller fish.
- Trimming Lake Superior fish significantly reduces PCBs and other pesticides, but not mercury.
- Cooking reduces PCBs and other pesticides in Lake Superior fish, but not mercury.

Studies on contaminants in fish have been undertaken since the early 1970’s and continue to increase in their number and complexity. For instance, each of the states bordering Lake Superior publish and distribute “Fish Consumption Advisories.”

Tribes have also been active in conducting assessments to determine contaminant levels in fish harvested and eaten in reservation communities. Because of the numerous studies conducted, scientists are able to provide recommendations that can help you reduce your exposure to chemical contaminants in fish.

While chemical contaminants are found and regulated in many foods, easy access to information regarding the levels of chemical contaminants or recommendations to reduce your exposure from them is rarely publicized for consumers. Chemical contaminants also are present at various levels in foods such as milk, eggs, potatoes, meat fruits, and vegetables, although they have not received the attention given to fish. The information provided in this supplement allows readers to consider and apply advice to reduce your exposure from freshwater fish. The more you apply advice, the more likely you will be able to reduce your exposure.

Sensitive populations are considered to be women intending to have children, pregnant women, breast-feeding mothers, and children under 15 years of age. It is important for women planning to have children to reduce their risk from chemical contaminants in all foods including fish.

A fetus is very sensitive to methylmercury poisoning because its nervous system is developing. Also, some scientific studies have reported impacts on infant (See Risk related to size and species, page 3)
Risk related to size and age

(Continued from page 1)

and child development from PCBs. If you are within this special population, you should carefully select the locations, types, and sizes of fish you plan to eat.

**General populations** are considered women not planning to become pregnant and men. These individuals are considered to be at less risk and can safely consume fish with higher levels of chemical contaminants. While risks to sensitive populations are connected to abnormal infant and child development, risks to the general population are most commonly related to an increase chance for cancer. However, it is important to keep the perceived risk of cancer from eating fish in perspective.

As noted in the “Minnesota Fish Consumption Advisory,” May 2000: “At worst, using the EPA method to calculate risk from a lifetime of eating contaminated fish, it is estimated that approximately one additional cancer case may develop in 10,000 people eating contaminated fish.”

**Contaminant levels in fish vary by location**

Choose lakes that are known to have fish with lower levels of contaminants

Contaminant levels in fish vary between lakes. If you or your family members are in the sensitive population, select fish from waters that have been shown to have lower contaminant levels. The graph below shows that PCB concentrations in lake trout have been decreasing throughout the Great Lakes and have historically been the lowest in Lake Superior (see Graph 1). If you are eating fish from inland waters, refer to GLIFWC’s Mercury Contamination of Walleye (Ogaa) maps to select harvest locations.

**Contaminant levels vary by fish species**

As a general rule and absent any other information, choose fish that don’t eat other fish. Some contaminants can build up in ever increasing amounts as small insects are eaten by small fish, which in turn are eaten by larger fish.

For example, Table 1 shows that a Lake Superior lake trout, a predator known to eat other fish, has PCB levels 7 times greater than a similar sized whitefish, a species that eats aquatic insects. Table 1 also shows the methylmercury level in lake trout was found to be 2.5 times greater than whitefish.

GLIFWC documented that Lake Superior whitefish and lake herring had low chemical contaminant levels, so by choosing these species, women of child-bearing age and children can get health benefits from eating fish while reducing their risk from chemical contaminants.

Both lake trout & whitefish meet FDA restrictions

Whitefish are significantly lower in contaminants

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<thead>
<tr>
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<th>PCBs</th>
<th>Methylmercury</th>
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<tbody>
<tr>
<td>Whitefish</td>
<td>0.0323</td>
<td>0.065</td>
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<td>0.229</td>
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(Table 1. Both of these fish species fall below FDA contaminant restrictions. This information has been presented to illustrate the point that predators often have higher contaminant levels than fish that do not eat other fish.)

**Contaminant levels in fish vary by size**

As a general rule and absent any other information, choose smaller fish. As fish grow, they take in more contaminants from their food and environment. You can reduce your exposure to environmental contaminants by choosing smaller sizes of a particular fish. Table 2 shows that lake trout between 27-28 inches have 1.7 times the levels of PCBs than found in lake trout between 25-26 inches. Furthermore, the 27-28 inch lake trout had over two times the levels of methylmercury found in lake trout between 25-26 inches in size.

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The benefits of eating fish, a traditional source of nutrition for the Ojibwe, often go unrecognized today.

In November, 1995 Dr. Harriet V. Kuhnlein, McGill University, prepared a report for the Mille Lacs Band of Chippewa entitled Ojibwe Health and Traditional Food Use. Building upon many years of work with McGill University, the Canadian government, and native communities, Dr. Kuhnlein identified many important relationships between traditional foods, nutrition, and current health conditions in tribal communities. Excerpts of Dr. Kuhnlein’s findings are as follows:

**What are the food-related health problems of the Ojibwe and Band members?**

Food-related chronic disease for the Wisconsin and Minnesota Ojibwe...are documented to include obesity, diabetes and its complications, cardiovascular diseases including hypertension, gall-bladder disease and dental disease...

**Can traditional Ojibwe food be used to improve the diet of Band members?**

In addition to improving diet and thereby contributing to health promotion, traditional Ojibwe food can be used to improve general well-being. Literature review and interview research results demonstrated that harvesting and use of traditional Ojibwe food are cultural activities that can impart connectedness to the environment and to Ojibwe society. These activities have emotional, educational, and spiritual values that promote cultural morale and mental health. Band members strongly agreed that the cultural values of harvesting and using traditional Ojibwe food were important to them in many ways and should be taught to their children.

**Health Canada promotes native foods and nutritional education to improve health**

The mission of Health Canada is to help the people of Canada maintain and improve their health. As part of this mission, Health Canada has prepared, published, and disseminated educational information regarding the health benefits of native foods including fish.

Using Native Foods and Nutrition—An Illustrated Reference Manual, Health Canada works with aboriginal peoples to:

- Help individuals and communities choose native foods wisely, to substitute as needed with non-traditional foods, and to include a greater variety of foods that meet their nutrient requirements, it is recommended for each native foods, including fish.
- Provide a better understanding of the effect of changing food habits on nutrition and health.
- Promote an understanding of the current and potential contribution of native foods to good nutrition and health.
- Increase the knowledge of the cultural and nutritional value of native foods in Canada.
- Decreased the current and potential contribution of native foods to good nutrition and health.
- Fish prepared over an open fire—a tasty, tantalizing and nutritious meal associated with some of the best time outdoors and is traditionally served at many Ojibwe feasts. (Photo by Aanooce.)

**Nutritional levels in fish**

The nutritional values for whitefish are presented in Health Canada’s Nutrient Bar Graphs—An illustrated guide to the nutrient value of some foods used by aboriginal people in Canada.

The Nutrient Bar Graph enables readers to tell whether a serving of food is an important source of energy, and the graph reports on ten selected nutrients needed for good health: fat, carbohydrate, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and vitamin C.

The left-hand side of the bar graph (y-axis) gives the percentage of Recommended Nutrient Intake (RNI) for a female teenager, aged 10 to 15.

Health Canada chose a teenage girl because “her needs for essential nutrients are highest at this stage in her life. If a food makes a significant contribution to her nutrient requirements, it will also do so for other age groups.”

If a food contains more than 33% of the amount recommended for each nutrient, it is represented by a
Fish continue to be culturally and nutritionally important

(Continued from page 3)

<table>
<thead>
<tr>
<th>Energy and nutrients</th>
<th>90 gram (3.17 oz) serving of broiled whitefish - percent RNI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>8% (176)</td>
</tr>
<tr>
<td>Fat</td>
<td>12% (10.2 grams)</td>
</tr>
<tr>
<td>Protein</td>
<td>50%</td>
</tr>
<tr>
<td>Calcium</td>
<td>3%</td>
</tr>
<tr>
<td>Iron</td>
<td>8%</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>12%</td>
</tr>
<tr>
<td>Thiamin</td>
<td>13%</td>
</tr>
<tr>
<td>Riboflavin</td>
<td>5%</td>
</tr>
<tr>
<td>Niacin</td>
<td>41%</td>
</tr>
</tbody>
</table>

Table 4

Numerous scientific studies have documented the health benefits of eating fish

- Dick Gurnoe, Red Cliff tribal fisherman, harvests lake trout and whitefish from Lake Superior to provide his customers with nutritious fish, high in omega-3 oils.

Also, omega-3, long-chain polyunsaturated fatty acids found in several native species of Lake Superior fish are important in the development of the central nervous system (brain) and the retina (eye) of fetuses and young children.

**It is very important for women planning to have children to reduce their risks from chemical contaminants in all foods including fish. The fetus is very sensitive to mercury poisoning. Some scientific studies have reported impacts on infant and child development from PCBs. You can limit your exposure to chemical contaminants in fish prior to pregnancy, during pregnancy, and while breast-feeding by carefully selecting the locations, types, and sizes of fish to be eaten (See Advice to consider when eating fish, page 15.).

Lake Superior fish have high amounts of omega 3 oils. One 8 ounce meal of siscowet trout per month, 2 meals of whitefish, 2 meals of lake trout, or 3 meals of lake herring each month would meet this requirement of 5.5 grams/month.

**Consuming 1 to 2 meals of fish per week can reduce the risk of death by coronary heart disease**

A project entitled “Comparative Dietary Risks: Balancing the Risks and Benefits of Fish Consumption,” funded by the U.S. Environmental Protection Agency (EPA) and conducted by Toxicology Excellence for Risk Assessment, reviewed 13 research projects that studied the relationship between fish consumption and reduced risk of death due to coronary heart disease (CHD).

Ten of the 13 studies found that consuming 1 to 2 meals of fish per week (fat or lean) reduced the risk of death due to coronary heart disease by 25 to 58% over those who ate little or no fish. These studies followed both men and women, both middle-aged and elders. The researchers concluded there was strong scientific evidence that consuming 1-2 meals of any fish a week reduces the risk of death due to coronary heart disease.

As explained by Dr. Paul Addis, UW-Minnesota, in his paper, “Omega-3 Fatty Acid Content in Lake Superior Fish,” and in several of the research papers previously referred to, fish species with greater amounts of omega-3 fatty acids diminished the risk of heart disease. One study found the more omega-3 fatty acids a person consumed (upper limit of study was 42 grams/month), the lower their risk of death due to coronary heart disease. Specifically, the study reported that an average intake of 5.5 grams of omega-3 fatty acids per month reduced on average the risk of coronary heart disease by 50 percent.

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It is important to realize that eating fish is a learned behavior. If parents do not serve fish to their children, children are unlikely to eat fish as they become older. This can have long term impacts on the health of families and reservation communities. A modern day challenge for parents is to learn how to reduce risks from chemical contaminants while encouraging children to continue the tradition of eating fish.
GLIFWC’s Lake Superior fish sampling and contaminant testing programs

Overall Findings
- All lake trout, whitefish, and herring samples tested under this project were below U.S. FDA action limits that restrict commercial sales for chemical contaminants.
- Concentrations of chemical contaminants varied between Lake Superior fish species. Fish lower in the food chain, such as whitefish and lake herring, had significantly lower PCB, chlordane, and mercury concentrations than predators such as lake trout and siscowet trout.
- The concentration of chemical contaminants such as PCBs, chlordane, and mercury increased with age and length of the fish.
- Trimming fillets and removing skin significantly reduced the concentration for PCBs, chlordane, and other organic persistent contaminants.
- Trimming fillets and removing skin did not reduce mercury concentrations in Lake Superior Fish due to mercury being bound to muscle tissue.

Project design
In designing the project, GLIFWC realized the study needed to address the following:
- Adequate sample size and statistical power to determine if the test results were less than the FDA action levels and state contaminant guidelines;
- Analyzed fish tissue needed to be representative of the edible portion that is to be sold;
- Analytical results needed to be supported by good quality control and quality assurance procedures including documentation.

Furthermore, in order to limit the number of samples needed to be analyzed, the following were considered:
- Within a species, larger and older fish tend to have higher contaminant concentrations;
- Species of fish at the top of the food chain tend to have higher contaminant concentrations than species of fish lower in the food chain;
- A single species of fish from a given water body tends to be exposed to similar amounts of environmental contaminants.

Collecting Lake Superior fish samples
Sample size ranges were selected after analyzing data of the lengths of Lake Superior fish measured from the tribal commercial catch from 1986 to 1999. Within a species, up to 48 fish were collected per size range.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Size Range (in)</th>
<th>No. Composites (C)</th>
<th>No. Fish/C</th>
<th>Total No. Fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>siscowet</td>
<td>17.0-18.0</td>
<td>4</td>
<td>12</td>
<td>48</td>
</tr>
<tr>
<td>siscowet</td>
<td>19.5-20.5</td>
<td>4</td>
<td>12</td>
<td>48</td>
</tr>
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<td>siscowet</td>
<td>22.0-23.0</td>
<td>4</td>
<td>12</td>
<td>48</td>
</tr>
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<td>siscowet</td>
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</tr>
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<td>25.0-26.0</td>
<td>4</td>
<td>12</td>
<td>48</td>
</tr>
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<td>lake trout</td>
<td>27.0-28.0</td>
<td>4</td>
<td>12</td>
<td>48</td>
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<tr>
<td>lake trout</td>
<td>27.0-28.0</td>
<td>3</td>
<td>8</td>
<td>24</td>
</tr>
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<td>22.0-24.0</td>
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(Table 6)

With the help of tribal fishermen, GLIFWC and tribal biologists collected four species of fish from the southern shore of Lake Superior (See map). Fisheries biologists then measured fish for total length, recorded their round weight, determined their sex, and collected otoliths and scales for aging purposes. Each fish collected was then tagged, placed into a specialized storage bag, cooled, and placed into a freezer.

A chain-of-custody form was also started for each species of fish collected from a given location on a given date and updated as samples were transferred between freezers and laboratories. This enabled GLIFWC to trace back testing results to the specific fish collected and at a specific sampling location.

Lake Superior management units in U.S. waters and areas of collection for ANA-HACCP contaminant analysis

Processing Lake Superior fish samples
All fish were aged using standardized techniques adopted by the Lake Superior Technical Committee of the Great Lakes Fishery Commission. Each set of 48 similarly-sized fish was then divided into 4 groups of up to 12 similarly-aged fish.

Fish samples were then processed at the Lake Superior Research Institute (LSRI), UW–Superior, Superior Wisconsin. Larry Brooke, LSRI research chemist, and Joe Duffy, Red Cliff tribal fisherman, teamed their talents to process the fish samples. Two fillets were collected from each fish. One fillet was processed raw and divided into three separate tissues of skin, muscle, and fatty tissue and the other fillet was saved for commercial smoking. During this process, data was also recorded on weights and water content of samples. Laboratory staff then cut skin and fat tissue into small pieces, froze the tissue with liquid nitrogen, and ground the tissue into a coarse powder. Muscle tissue was also ground. Similar tissues (i.e. skin, muscle, or fatty tissue) were then combined from two fish of similar age to form a single composite sample.

An equal weight of each set of tissues (skin, muscle or fatty tissue) was combined (composed) into a single sample and placed into several special sample bottles and stored in a freezer. Chain-of-custody forms were then updated and samples were sent to EN CHEM, Inc. analytical laboratory in Madison, Wisconsin for chlorinated organic chemical analysis. Samples were also archived for future research.

(See Sampled Lake Superior fish, page 6)

All lake trout, whitefish, and herring samples tested under this project were below U.S. FDA action limits that restrict commercial sales for chemical contaminants.

Realizing that the treaty fishery and its markets are impacted by publicity surrounding fish contaminant issues and FDA’s new Seafood safety regulations, GLIFWC contracted funding from the Administration for Native American’s (ANA) program to undertake a contaminant study of Lake Superior fish and develop a tribal regulatory structure in compliance with FDA’s Hazard Analysis Critical Control Point (HACCP) seafood safety regulations. Tribes were particularly interested in determining how the removal of belly and back fat from Lake Superior fish could reduce chemical contaminant levels in the edible portion of fish sold by tribal fishermen.

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Processing Lake Superior fish samples
All fish were aged using standardized techniques adopted by the Lake Superior Technical Committee of the Great Lakes Fishery Commission. Each set of 48 similarly-sized fish was then divided into 4 groups of up to 12 similarly-aged fish.

Fish samples were then processed at the Lake Superior Research Institute (LSRI), UW–Superior, Superior Wisconsin. Larry Brooke, LSRI research chemist, and Joe Duffy, Red Cliff tribal fisherman, teamed their talents to process the fish samples. Two fillets were collected from each fish. One fillet was processed raw and divided into three separate tissues of skin, muscle and fatty tissue and the other fillet was saved for commercial smoking. During this process, data was also recorded on weights and water content of samples. Laboratory staff then cut skin and fat tissue into small pieces, froze the tissue with liquid nitrogen, and ground the tissue into a coarse powder. Muscle tissue was also ground. Similar tissues (i.e. skin, muscle, or fatty tissue) were then combined from two fish of similar age to form a single composite sample.

An equal weight of each set of tissues (skin, muscle or fatty tissue) was combined (composed) into a single sample and placed into several special sample bottles and stored in a freezer. Chain-of-custody forms were then updated and samples were sent to EN CHEM, Inc. analytical laboratory in Madison, Wisconsin for chlorinated organic chemical analysis. Samples were also archived for future research.

(See Sampled Lake Superior fish, page 6)
testing Lake Superior fish samples

Each composite sample was analyzed for total mercury, polychlorinated biphenyls (PCBs) as aroclor mixtures, and a suite of chlorinated pesticides. Mercury testing was completed at the Lake Superior Research Institute at the U.W. Superior and the University of Minnesota-Duluth. Chlorinated organic analyses were conducted by EN CHEM, Inc. of Madison, Wisconsin.

Polychlorinated biphenyls (PCBs) findings

- None of the Lake Superior fish samples (lake herring, whitefish, lake trout, or siscowet trout) exceed the U.S. FDA’s PCB action limit for commercial sales.
- Polychlorinated biphenyls (PCBs) findings

Trimming fillets lead to reduced PCB contaminant levels by 12% to 40% depending on the fish species. For example, PCB contaminant levels in siscowet trout were reduced 23-25%. PCB contaminant levels in siscowet trout were reduced between 12-40% depending upon the length of the fish. (See Trimmed Skin-On figures in Table 7.)
- Removing skin from fillets further reduced PCB concentrations in whitefish, lake trout, and siscowet trout between 17 and 20.5 inches. (See Trimmed Skin-Off figures in Table 7.)

Polychlorinated Biphenyls (PCBs) in Three Types of Lake Superior Fillets

Chlordane findings

None of the Lake Superior fish samples of lake herring, whitefish, or lake trout exceeded the U.S. FDA’s chlordane action limit of 300 ppb (0.3 ppm) for commercial sale.
- Siscowet samples in the 17-18 inch size group and the 19.5-20.5 inch size group did not exceed the U.S. FDA’s chlordane action limit of 300 ppb (0.3 ppm). Siscowet from the 22-23 inch size group and 24.5-25.5 inch size group exceeded the U.S. FDA’s chlordane action limit of 300 ppb (0.3 ppm). Trimming fillets led to reduced chlordane concentration levels by 13% to 38% depending on the fish species. For example, chlordane concentration levels in whitefish were reduced 33% and in lake trout 34%. Chlordane concentration levels in siscowet trout were reduced between 13-38% depending upon the length of the fish. (See Trimmed Skin-On figures in Table 8.)
- Removing skin from fillets further reduced chlordane concentrations in whitefish, lake trout, and siscowet trout between 17 and 20.5 inches. (See Trimmed Skin-Off figures in Table 8.)

### Table 7: Chlordane findings

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Length Range</th>
<th>Concentration (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Herring</td>
<td>15 - 17</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td>Whitefish</td>
<td>17 - 24</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td>Lake Trout</td>
<td>25 - 28</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td>Siscowet Trout</td>
<td>17 - 18</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td></td>
<td>19.5 - 20</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td></td>
<td>22 - 24</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td></td>
<td>24.5 - 25.5</td>
<td>Below FDA limits</td>
</tr>
</tbody>
</table>

### Table 8: Polychlorinated Biphenyls (PCBs) in Three Types of Lake Superior Fillets

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Length Range</th>
<th>Concentration (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Herring</td>
<td>15 - 17</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td>Whitefish</td>
<td>17 - 24</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td>Lake Trout</td>
<td>25 - 28</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td>Siscowet Trout</td>
<td>17 - 18</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td></td>
<td>19.5 - 20</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td></td>
<td>22 - 24</td>
<td>Below FDA limits</td>
</tr>
<tr>
<td></td>
<td>24.5 - 25.5</td>
<td>Below FDA limits</td>
</tr>
</tbody>
</table>

### Graph 3: Polychlorinated Biphenyls (PCBs) in Three Types of Lake Superior Fillets

- Graph 3: Polychlorinated Biphenyls (PCBs) in Three Types of Lake Superior Fillets
- Graph 4: Species and Length Groups (inches)

Joe Duffy, Red Cliff commercial fisherman, (left) assisted by Ben Pfaff, University of Wisconsin-Superior student, processes fish samples for contaminant testing at the Lake Superior Research Institute, U.W.-Superior. (Photo by Charlie Otto Rasmussen.)

Testing Lake Superior fish samples

Joe Duffy, Red Cliff commercial fisherman, (left) assisted by Ben Pfaff, University of Wisconsin-Superior student, processes fish samples for contaminant testing at the Lake Superior Research Institute, U.W.-Superior. (Photo by Charlie Otto Rasmussen.)
Lake Superior fish are tested for mercury

(Continued from page 6)

Using test results from 22 composite samples and linear regression, GLIFWC has determined that Lake Superior commercial fishermen could harvest and process siscowet trout up to 22 inches without exceeding FDA’s action limit for chlordane of 300 ppb (0.3 ppm). If the belly and back fat is removed from the fillets (note: see Total Chlordane Concentrations in Untrimmed and Trimmed Skin-on Siscowet Fillets from the South Shore of Lake Superior, Graph 5)

<table>
<thead>
<tr>
<th>Length Group (inches)</th>
<th>Processing</th>
<th>Age (Range)</th>
<th>Location (see map)</th>
<th>Number of Composites</th>
<th>Total Mercury</th>
<th>Exceeds US FDA Action Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Herring (Total = 48 fish):</td>
<td></td>
<td></td>
<td>9 (7 to 15)</td>
<td>M-4</td>
<td>107 65 149</td>
<td>No</td>
</tr>
<tr>
<td>Lake Whitefish (Total = 47 fish):</td>
<td></td>
<td></td>
<td>9 (7 to 15)</td>
<td>M-4</td>
<td>81 52 70</td>
<td>No</td>
</tr>
<tr>
<td>Trimmed Skin-On</td>
<td>Trimmed Skin-Off</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake Trout (Total = 128 fish):</td>
<td></td>
<td></td>
<td>9 (6 to 14)</td>
<td>M-4</td>
<td>143 115 171</td>
<td>No</td>
</tr>
<tr>
<td>Siscowet Trout (Total = 230 fish):</td>
<td></td>
<td></td>
<td>13 (15 to 17)</td>
<td>M-4</td>
<td>179 148 210</td>
<td>No</td>
</tr>
<tr>
<td>Lake Trout</td>
<td>Lake Whitefish</td>
<td>Lake Herring</td>
<td>Siscowet Trout</td>
<td>Total Chlordane Concentrations in Untrimmed and Trimmed Skin-on Siscowet Fillets from the South Shore of Lake Superior</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Mercury Concentrations in Three Types of Lake Superior Fish Fillets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Methylmercury action limit for commercial sales of 1000 ppb (1.0 ppm).

Concentrations of chemical contaminants varied between Lake Superior fish species. Fish lower in the food chain, such as whitefish and lake herring, had significantly lower PCB, chlordane, and mercury concentrations than predators such as lake trout and siscowet trout.

<table>
<thead>
<tr>
<th>Species and Length Groups (inches)</th>
<th>Total Mercury Concentration (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Trout (15-17)</td>
<td>15-17</td>
</tr>
<tr>
<td>Lake Trout (25-29)</td>
<td>25-29</td>
</tr>
<tr>
<td>Lake Trout (17-19)</td>
<td>17-19</td>
</tr>
<tr>
<td>Lake Trout (22-23)</td>
<td>22-23</td>
</tr>
<tr>
<td>Lake Trout (15-17)</td>
<td>15-17</td>
</tr>
<tr>
<td>Lake Trout (22-23)</td>
<td>22-23</td>
</tr>
<tr>
<td>Lake Trout (15-17)</td>
<td>15-17</td>
</tr>
<tr>
<td>Lake Trout (22-23)</td>
<td>22-23</td>
</tr>
<tr>
<td>Lake Trout (15-17)</td>
<td>15-17</td>
</tr>
<tr>
<td>Lake Trout (22-23)</td>
<td>22-23</td>
</tr>
</tbody>
</table>

(Continued from page 6)
Tribes and FDA cooperatively implement seafood safety regulations

The Anishinaabe have a long commercial fishing history

According to the teachings of the Anishinaabe people, (also known as Chippewa or Ojibwe), it was the sacred Megis Shell that first guided the people to the rich regions of the Great Lakes. Lake Superior was known as Gitchi (big) Gummi (water) to the Anishinaabe. Here tribal fishermen harvested fish using large birchbark canoes and gill nets constructed from twisted and knotted strands of willow bark. As Europeans pushed into the Great Lakes region, the Anishinaabe people used fish to trade with French and English outposts.

GLIFWC member tribes signed treaties with the United States in 1836, 1837, 1842, and 1854 which reserved the right to harvest fish from Lake Superior for subsistence, cultural, and commercial purposes. These rights have been upheld in state and federal court decisions over the last 29 years.

Today, a number of GLIFWC member tribes license and regulate treaty fishing in Lake Superior, including Red Cliff, Bad River, Keweenaw Bay, and Bay Mills. This fishery provides an important source of income and jobs for reservation communities while supplying significant harvests of fresh water fish (See Table 10 below).

Lake Superior tribal harvest (in round pounds)

<table>
<thead>
<tr>
<th>Species</th>
<th>1999</th>
<th>1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whitefish</td>
<td>1,444,904</td>
<td>1,749,784</td>
</tr>
<tr>
<td>Lake Trout</td>
<td>312,723</td>
<td>304,790</td>
</tr>
<tr>
<td>Siscowet</td>
<td>87,043</td>
<td>117,501</td>
</tr>
<tr>
<td>Herring</td>
<td>71,169</td>
<td>87,971</td>
</tr>
</tbody>
</table>

(Table 10. Data from extractions report file.)

New federal seafood guidelines are established

On December 18, 1997 the Seafood Hazard Analysis Critical Control Point (HACCP) regulation became mandatory. Under this federal law all fish processors are required to:

- Complete a HACCP training program;
- Develop and adopt a HACCP plan to fit the specific needs of a processor;
- Reassess and modify the plan annually as the result of verification activities;
- Maintain and review adequate HACCP records.

The HACCP process examines biological threats, chemical threats, and physical threats on a product-by-product basis. For the Lake Superior region, federal HACCP regulations require commercial fishermen and fish processors to address potential threats, such as botulism in smoked fish products, and to control bacterial levels in fish and chemical contaminants found in the environment.

The regulation is enforced by the FDA through on-site inspections of fish processors. The Detroit District inspects fish processors in Michigan, and the Minneapolis District inspects fish processors in Wisconsin and Minnesota. Sometimes federal HACCP inspections are conducted by FDA employees and other times FDA contracts with state agencies, such as the Michigan Department of Agriculture, to conduct federal inspections.

The new federal regulations apply to both domestic producers and foreign importers and were established because of consumer demand. While the new federal HACCP regulation will not impact tribal fishermen who harvest, gut, and sell fish at dockside to processors within 24 hours, it will impact tribal fish processing operations, tribal fishermen processing and selling their harvest through their own fillet markets, or tribal fishermen smoking and selling fish.

ANA provides critical resources to develop regulatory structures and implement new federal seafood safety regulations

Realizing the impacts of the new federal HACCP seafood safety regulations on tribal fishermen, GLIFWC applied for and received a $232,000 grant from the Administration for Native Americans (ANA).

The grant enabled tribes and FDA to cooperatively implement new federal seafood safety regulations for the purpose of maintaining a viable Lake Superior fishery capable of continuing tribal fishing traditions. Under the ANA grant, GLIFWC and its member tribes:

- Tested contaminants in commercially sold Lake Superior fish;
- Determined how the HACCP process could be used to address PCB, mercury, and chloridane contaminant concerns in fish; and
- Built the foundation for a regulatory system that reaffirms tribal self-regulatory authority over tribal fishermen while meeting federal HACCP fish safety requirements.

(See Tribes and FDA enter partnership agreement, page 9)
Tribes and FDA enter partnership agreement on regulation of harvested and processed fish

(Continued from page 6) Tribal fishermen complete HACCP training to improve the safety and quality of Lake Superior fish

Under the support from ANA and FDA’s Partnership Grant, four basic HACCP training sessions were held at Keweenaw Bay (2 sessions), Bay Mills (1 session), and Red Cliff (1 session). In these three-day training sessions, 62 tribal fishermen and tribal staff were trained in seafood safety techniques, including basic HACCP principles, developing HACCP plans, and record-keeping requirements.

The training helped tribal fishermen and processors to understand why regulations regarding fish contaminants exist and how these regulations will protect both the human health and safety of their families and their markets for fish harvested under treaty rights. As the training progressed, revisions were made to the sessions resulting from suggestions on evaluation forms. For instance, more demonstration activities and customized training materials were added. Participants completing the training received an official certificate from the Association of Food and Drug Officials.

GLIFWC and the Michigan State University (MSU) Sea Grant developed computer templates and a supplemental training manual for tribal regulators, fishermen, and processors that specifically addressed chemical contaminant levels in Lake Superior fish.

The training packet incorporated FDA and EPA guidance levels for chemical contaminants (i.e. PCBs, etc.) into “real world” HACCP Hazard Analysis Worksheet models and HACCP Plan models likely to be encountered by tribal regulators and tribal fishermen/processors on reservations.

In addition to the Basic HACCP Training sessions, twelve tribal staff members completed a one day class and test for seafood safety regulators. This testing process certified tribal staff as FDA HACCP seafood safety inspectors.

FDA Partnership Agreements for the 1842 waters of Lake Superior

Bad River, Red Cliff, and Keweenaw Bay entered into formal partnership agreements with FDA concerning the protection of public health related to the regulation of fish harvested from and processed in the Michigan 1842 ceded territory. This agreement meets federal HACCP Seafood Safety requirements while reaffirming tribal sovereignty.

Under the agreement, tribal governments and the FDA will work cooperatively to promote the inspection of fish and fishery products based on HACCP principles, participate in training to improve the efficiency of inspection programs, explore the most effective ways to protect the public health, and participate in the HACCP national data base for the purpose of fostering confidence in tribally harvested and processed fish products.

In coming months, GLIFWC will be working with member tribes to develop a model tribal HACCP code establishing regulations and inspection procedures. This code will be based upon federal regulations and integrate laboratory testing results on chlordane, PCBs, and mercury. By establishing tribal seafood safety regulations, conducting HACCP inspections, and referring violations into tribal court, member tribes will maintain the self-regulatory authority over tribal fishermen and processors.

Within the Partnership Agreement, the FDA will refer all complaints to the appropriate tribal official when a complaint is made to the FDA concerning a matter that is in violation of tribal fishing regulations. This reaffirms tribal sovereign authority.

Acknowledgments

The Administration for Native Americans (ANA) program provided funding for contaminant testing of Lake Superior fish, training tribal fishermen to process fish safely, and the development of the FDA partnership agreement. The projects would not have been possible without the participation and assistance from the following individuals:

Lake Superior fish sample collection and aging:
- Tribally licensed commercial fishermen Joe Duffy, Joe Newago, Alan Newago, Gilmore Peterson, Neil Malmgren, and Cec Peterson
- Mike Donofrio, Keweenaw Bay Biological Services Director
- Mike Gallinat, Red Cliff Fisheries Biologist
- Ed Leoso, Bad River Lake Superior Technician
- Bill Mattes, GLIFWC Great Lakes Section Leader
- Mike Plucinski, GLIFWC Great Lakes Technician
- Dan North and Kristen Anderson, Northland College Interns
- Chuck Smart, GLIFWC limited term employee

Laboratory processing and testing:
- Joe Duffy, Red Cliff Commercial Fisherman
- Larry Brooke and Christine Polkinghorn, Lake Superior Research Institute at the University of Wisconsin—Superior
- Tom Markee, En Chem Inc.
- Tod Noltemeyer, En Chem Inc.

Project and data managers:
- Kory Groetsch, GLIFWC Environmental Biologist
- Neil Kniecik, GLIFWC Biological Services Director
- Rick Madsen, GLIFWC Data Analyst
- Jennifer Knaeger, GLIFWC Data Base Manager
- Jim Thannum, GLIFWC Natural Resource Development Specialist

Technical advisors and instructors:
- Sally Eberhard, FDA Detroit District Office
- Michael Erdman, MSU Extension Service
- Timothy Treadway, Michigan Department of Agriculture
- Ron Kinnunen, MSU Sea Grant
- Ken Gephardt, Bay Mills Fisheries Biologist
- Ralph Wilcox, Wilcox Fishery

Joe Duffy and Shelly Garman use a hydrometer to test the salt content of fish brine solutions during a HACCP training session in Red Cliff. (Photo by Sharon Nelis.)
Buy, cook, and eat fish safely

To ensure that the fish you buy and eat is as safe as possible, follow these recommended guidelines:

- Think twice before you eat raw fish. You can never be absolutely sure the fish doesn’t harbor parasites or high levels of bacteria.
- Cook fish thoroughly until it is opaque and flakes easily with a fork. Overcooking makes it dry. The best way to learn the technique is to practice.
- When buying whole fish, look for bright, clear, bulging eyes. Cloudy, sunken, discolored or slime-covered eyes often signal fish that is beginning to spoil. The skin of freshly caught fish is covered with a translucent mucus that looks a bit like varnish. The color is vivid and bright. Avoid fish whose skin has begun to discolor, shows depressions, tears or blisters, or is covered with sticky, yellowish brown mucus.
- When buying steaks or fillets, look for moist fish that still has a translucent sheen. Watch out for flesh that is dried out or gaping—the muscle fibers are beginning to pull apart. That’s a sign of over-the-hill fish.

Controlling bacteria improves fish safety and taste

If you are fishing for either sport, subsistence, or commercial purposes, it is important to understand that bacteria impacts the quality and safety of fish. Fortunately, steps can be taken to control the growth of bacteria.

- Bacteria is naturally found in the slime, digestive tracts, gills, and exposed blood. It grows quickly, multiplying exponentially, after the fish is removed from the water. Bacterial growth is further increased if coolers, fish boxes, or other storage items are not properly cleaned. Once established, bacteria soon changes the texture, color, odor, and, most importantly, flavor of fish.

Don’t bruise your fish

Few people realize that fish flesh is easily damaged. If fish are bruised, enzymes are released. These enzymes soften the flesh and make nutrients available to bacteria. Food scientists have found that fish that have been bruised contain 10 times more bacteria than flesh from unbruised fish. By separating fish bruised in nets, fishermen can avoid having a few highly contaminated fish, accelerating spoilage of those fish that have not been bruised.

Properly ice your fish as soon as possible

It is important to properly ice fish. This is done by making a 1 to 2 inch bed of crushed ice, layering ice with fish, and topping the fish box or cooler off with 2 to 3 inches of additional ice. Icing fish provides the benefits of:

- Rapidly cooling the fish;
- Slowing bacterial growth and enzyme activity;
- Flushing out bacteria as the ice melts;
- Prevents drying;
- Improving texture by delaying rigor mortis in hot weather; and
- Improving texture by resisting freezing in cold weather.

Food scientists have conducted studies on bacterial growth that support the recommendation that fish be iced regardless of weather conditions. Their studies have also demonstrated that the flushing action of melting ice extended the shelf life of fish in coolers by controlling bacterial growth.

Controlling bacteria at your fish cleaning location

It is important to clean all surfaces that come into contact with fish, including cleaning fish boxes, slickers/train gear, knives, and gutting boards or tables. After cleaning fish, it is important to remember to first clean with a detergent. Then separately sanitize your fish shed by using 1 pint of unscented bleach to 12 gallons of water. You can improve the safety and taste of your fish if you follow these recommendations:

- Rinse surfaces to remove blood, scales, and other fish wastes.
- Brush with a warm noncaustic detergent solution.
- Rinse with clean water.
- Brush on chlorine sanitizer (unscented bleach).
- Allow to dry on plastic and wood. If you use a stainless steel table for cleaning fish, rinse with clean water.
- Rinse again with clean water right before cleaning fish.

It is important to remember that all of your cleaning efforts will mean little if you fail to properly wash your hands before handling fish products. Antibacterial soap and hand sanitizers can be used at any location and assist in maintaining high quality and safe food products.

Freezing freshwater fish

The quality of frozen fish is affected by several factors—prefreezing quality, handling during preparation, and protection by packaging during freezing and storage.

- Below are recommendations summarized from Michigan State University Cooperative Extension Service’s Commercial Freezing of Freshwater Fish, Extension Bulletin E-1323. If you are fishing for either sport, subsistence, or commercial purposes, following these recommendations will improve the safety and quality of your frozen fish.

### Storage times at 0°F

<table>
<thead>
<tr>
<th>Kind of fish</th>
<th>Taste like fresh</th>
<th>Maximum storage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FAT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>salmon, lake trout, rainbow trout, chubs, whitefish, smelt, lake herring, carp, catfish</td>
<td>3 months</td>
<td>9 months</td>
</tr>
<tr>
<td><strong>LEAN</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>northern pike, suckers, bluegills, bass, crappies and sunfish, walleye and yellow perch</td>
<td>6 months</td>
<td>12 months</td>
</tr>
<tr>
<td><strong>SMOKED</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 months</td>
<td></td>
</tr>
</tbody>
</table>

(The information summarized in this article is based upon Michigan State University Cooperative Extension Service’s Commercial Fish Handling and Sanitation on Great Lakes Vessels, Extension Bulletin E-1324.)

Food Safety NEWS

**FAT**

- salmon, lake trout, rainbow trout, chubs, whitefish, smelt, lake herring, carp, catfish

**LEAN**

- northern pike, suckers, bluegills, bass, crappies and sunfish, walleye and yellow perch

**SMOKED**

- 2 months

(Table 1. Reprinted from Freshwater Fish Preservation by the Michigan Sea Grant College Program, North Central Regional Publication 498, November 1994.)

- Note how the fish is displayed and look for clues that the temperature may be too high. Fish that are piled high, displayed in open cases or sitting under hot lights are perfect places for bacteria to grow. If fish fillets are displayed inside separate pans surrounded by ice, that’s usually a sign the retailer is paying some attention to quality. Whole fish should be displayed under ice.
- Keep an eye out for displays featuring cooked and raw fish or seafood next to each other. There is a potential health hazard from cross-contamination—transfer of bacteria from raw to cooked products. Buying anything from this kind of display can be risky.
- Use your nose. Fresh fish smell like the sea but have no strong odor. Freshwater fish in good condition sometimes smell like cucumbers. Strong odors usually indicate spoiled fish.
- Once you buy fish, refrigerate it quickly. At home, store it in the coldest part of your refrigerator, keep it in the original wrapper and use it fast—within a day.
- If you’re concerned about quality, look for evidence that fish has been frozen and then thawed. Look for chunks of ice floating in the fish liquid—a clue that the fish had been frozen. There’s nothing wrong with frozen fish that’s been thawed, but if you unknowingly refreeze it, its texture and flavor will suffer. It’s probably better to buy frozen fish instead.

(Your information was reprinted from Food Safety NEWS published by Michigan State University, Cooperative Extension Service, Spring 1992.)

Falling supplement 2000
Tips for keeping smoked fish safe

Smoked Lake Superior fish has been enjoyed by the Anishinaabe and their visitors for hundreds of years. This regional delicacy remains available today at numerous locations along Lake Superior’s south shore (See Tribal retail & wholesale outlets, page 12). Smoked fish customers are often under the impression that smoked fish is “preserved” and does not need to be refrigerated. This is wrong and could be a deadly mistake. Remembering a few important points will protect the health and safety of your family when transporting and storing smoked fish.

Botulism toxins can be deadly

Clostridium botulinum, commonly referred to as botulism, is found in soil, water, vegetables, meats, dairy products, and fish. The botulism toxin develops from spores of the botulism bacteria. These spores grow and produce a toxin when non-acid food (e.g., meat, fish, poultry, and vegetables) is held in an air-tight container such as a plastic bag or cans. Botulism is both deadly and hard to detect since it produces little noticeable evidence of spoilage. Because botulism produces heat-resistant spores and requires the absence of oxygen for growth, it has been commonly associated with improperly canned food (usually home canned).

Botulism toxins are easily controlled

While the botulism toxin can be deadly, it is easily controlled. Using Hazard Analysis Critical Control Point (HACCP) techniques, Lake Superior fish smokers ensure proper salt content in their brining solutions. Fish smokers also ensure adequate cooking times (i.e. a minimum of 30 minutes) and temperatures (i.e. a minimum of 145°F) to destroy the bacteria that produces the botulism toxins.

Refrigerate smoked fish

Lake Superior fish smokers also use HACCP techniques to ensure that smoked products are stored at proper temperatures (38°F or below) and are properly labeled. Customers reading the labels provided on smoked fish products will find these products must be:

* kept refrigerated at or below 38°F, and
* eaten by a specified expiration date.

Ensuring that your smoked fish is in a refrigerated condition will keep you and your family safe and returning for more of Lake Superior’s famous smoked fish.

Freezing freshwater fish

(Continued from page 10)

- Keep your freezer cold. A storage temperature of -20°F or colder is strongly recommended by food scientists. When stored at 0°F, fish have only half the storage life possible at -20°F.
- Thawing fish in still air is not recommended—the surface of the fish will warm, become soft and begin to spoil before the center thaws. Thawing fish under refrigeration (35 to 40°F) or submerging securely packaged fish in cold running water is recommended. It is important to remember that thawed fish deteriorate rapidly due to the release of enzymes and nutrients for bacteria growth.
- Avoid thawing and refreezing fish. The flesh becomes mushy and dry when cooked.

Contaminant results good in Whitefish Bay

Sault Ste. Marie, Mich.—There’s good news for people who like to eat fish. Lake Superior fish are well below government guidelines for safe consumption. Lake Superior whitefish and lake trout collected from commercial catches in the Whitefish Bay area (MI-8) recently tested well below state and federal guidelines.

Contaminant levels of Lake Superior Fish were analyzed as part of a long-term fish contaminant monitoring program conducted by the Inter-Tribal Fisheries and Assessment Program (ITFAP) in order to determine contaminant levels in Lake Superior fish. Results from independent laboratory analysis are compared to contaminant levels determined to be safe by various government agencies. ITFAP, also shares the results with these agencies, including the Michigan Department of Public Health.

Lake Superior fish were tested for a wide range of contaminants, including mercury, PCBs, dioxins and pesticides such as DDT. All fish were considerably below the guidelines for commercial fish issued by the U.S. Food and Drug Administration (FDA) and below the Michigan Department of Public Health’s guidelines for consumption of sport fish by the general public.

Lake Superior fish were remarkably low in mercury, especially when compared to levels of mercury found in fish from most inland lakes. Mercury, mostly from sources such as coal burning electrical plants, accumulates in rain and snow and then concentrates in Lake Superior and in the smaller inland lakes.

Levels of pesticides such as DDT, which was banned in the United States in the 1970s, are also remarkably low in Lake Superior fish. Contaminant levels in fish from all of the Great Lakes have declined dramatically since the 1970s, when regulations were put in place to reduce pollution.

These results are encouraging for those who enjoy eating Great Lakes fish, especially since studies show that most Americans eat a diet high in saturated and trans fats.

Most Americans could dramatically reduce their risk of heart attack and stroke by switching to a more lean protein source, such as properly prepared fish (fillet and cook with no additional fat).

Other studies also show that a different type of fat, Omega-3 fatty acids, significantly reduces the risk of heart disease and may actually reduce the risk of cancer. Great Lakes fish (like whitefish, lake trout, or chub) are especially high in Omega-3 fatty acids.

For more information, contact Mike Ripley, ITFAP Environmental Coordinator, at 906-632-0072.

Testing reveals good news on Lake Superior fish contaminant levels

(Continued from page 7)

<table>
<thead>
<tr>
<th>Chemical</th>
<th>FDA Action Level (ppb)</th>
<th>Lake Herring (15-17 in.) Mean (Range)</th>
<th>Lake Whitefish (22-24 in.) Mean (Range)</th>
<th>Lake Trout (25-26 in.) Mean (Range)</th>
<th>Lake Trout (27-28 in.) Mean (Range)</th>
<th>Siscowet Trout (29-30 in.) Mean (Range)</th>
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<tbody>
<tr>
<td>Benzene hexachloride</td>
<td>300</td>
<td>0 (0-0)</td>
<td>1.5 (0-7.0)</td>
<td>6.2 (5-7.3)</td>
<td>5.8 (4-7.0)</td>
<td>4.4 (3-5.6)</td>
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<td>DDT &amp; metabolites</td>
<td>5000</td>
<td>3.8 (0-20)</td>
<td>4.8 (0-30)</td>
<td>130 (85-170)</td>
<td>230 (150-300)</td>
<td>630 (260-1000)</td>
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<td>Aldrin/Dieldrin</td>
<td>300</td>
<td>7.2 (0-8.6)</td>
<td>26 (0-32)</td>
<td>36 (23-48)</td>
<td>79 (62-90)</td>
<td>78 (60-120)</td>
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<tr>
<td>Heptachlorocarbon</td>
<td>300</td>
<td>0 (0-0)</td>
<td>10 (0-0)</td>
<td>5.9 (0-0)</td>
<td>6.8 (0-0)</td>
<td>12 (0-0)</td>
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<tr>
<td>Heptachlorophosphine</td>
<td>100</td>
<td>0 (0-0)</td>
<td>0 (0-0)</td>
<td>7.8 (0-0)</td>
<td>7.8 (0-0)</td>
<td>12 (0-0)</td>
</tr>
</tbody>
</table>

*All Lake Superior fish samples (lake herring, lake whitefish, lake trout, or siscowet trout) were far below the U.S. FDA’s action limit for these chemicals. (See Table 11.)

GLIFWC’s Lake Superior study was conducted in the western and central portions of Lake Superior. ITFAP’s study was conducted in the eastern portion of Lake Superior. (See story below.)

Newago’s smoked fish products contain labels stressing the importance of keeping smoked fish refrigerated. These labels help to ensure the safety of their customers and promote family owned businesses. Newago’s Fish Market is located in Chassell, Michigan. (Photo by Jim Thannum.)
Tribal retail & wholesale outlets

Eastern
Lake Superior region

Clear Water Cooperative
Jamie Manysy
P.O. Box 114
Moran, MI 49760
(906) 643-9147

Bob's Fish
Lakeshore Drive
Brimley, MI 49715
(906) 248-5764

Lothrop Fish Market
Route 1, Lakeshore Drive
Brimley, MI 49715
(906) 248-3640

Wilcox Fishery
Lakeshore Drive
Brimley, MI 49715
(906) 437-5407

Brown's Fish Market
Hwy. 123
Paradise, MI 49768
(906) 492-3313

Central
Lake Superior region

Smack's Smoked Fish
Richard Semasky
Pequaming Road
L'Anse, MI 49946
(906) 524-6073

Joe Dowd
P.O. Box 462
L'Anse, MI 49946
(906) 524-5167

Newago Fisheries
Route 1, Box 508
Chassell, MI 49916
(906) 532-FISH (3474)

Peterson's Fish Market
Route 1, Box 219
Hancock, MI 49930
(906) 482-2343

Western
Lake Superior region

Jack's Fish
P.O. Box 72
Odanah, WI 54861
(715) 682-2052 or
(715) 682-5631

Peterson's Fisheries
P.O. Box 766
Bayfield, WI 54814
(715) 779-5023

Gurnoe & Sons Fishery
Rte. 1, Box 89
Bayfield, WI 54814
(715) 779-3613

Auntie Grampa's Specialties Inc.
Skip and Debbie Hipsher
HCR 62, Box 44D
Iron River, WI 54847
(715) 372-5221

Commercial tags at Red Cliff continue tribal fishing traditions that have been carried on for centuries in the Apostle Islands. By improving seafood safety and quality, tribal fishermen ensure a viable Lake Superior fishery is maintained for their suppliers and customers. (Photo by Jim Thannum.)

Joe Dowd

Wisconsin. Jack Pero provides his customers with both fresh and smoked Lake Superior fish. (Photo by Jim Thannum.)

Lothrop Fish Market operated by Eddie Lothrop, sells fresh whitefish and lake trout at Brimley, Michigan. (Photo by Charlie Otto Rasmusen.)

Peterson's Fish Market, Hancock, Michigan, is a family business owned and operated by the Peterson family. From the left, (back row) Gilmore and Pat Peterson; (front row) Tami Peterson and Ray Defoe. (Photo by Jim Thannum.)

Jack's smoked fish can be found on US 2 about eight miles east of Ashland, Wisconsin. Jack Pero provides his customers with both fresh and smoked Lake Superior fish. (Photo by Jim Thannum.)
Joe Dowd is known for his custom smoked fish throughout the L’Anse and Baraga area of Michigan. (Photo by Jim Thannum.)

Peterson’s Fish Market sells smoked fish, smoked fish spreads, and smoked fish sausage. (Photo by Jim Thannum.)

Smoked fish provides gourmet specialties

**Smoked Trout Salad**

6-8 servings

_Smoked Trout Salad_

2 cups fresh spinach, broken
2 cups red lettuce, broken
2 cups romaine lettuce, broken
18 ounces smoked trout, flaked
1 cup slivered almonds

_Vinagrette Dressing_

1/2 cup lemon juice
1/4 cup orange juice concentrate
1 tablespoon white wine vinegar
1 tablespoon dijon-style mustard
3/4 cup mayonnaise
Salt and white pepper to taste
1 1/2 tablespoons minced shallots
2 tablespoons chopped cilantro
1 cup diced tomatoes

_Salad_

1. Toss the greens together and place on chilled plates.
2. Place flaked trout on greens.
3. Sprinkle with almonds.
4. Drizzle with dressing.

_Vinagrette Dressing_

1. Blend the first five ingredients in food processor.
2. Salt and pepper to taste.
3. Place in medium sauce pan. Stir in the shallots, cilantro and tomatoes.
4. Heat just to boiling point. Remove from heat.

_Smoked Trout Salad with wild rice_

_Salad:_

1-1 1/2 pounds smoked lake trout fillets
1 1/2 cups grated cheddar cheese
1/4 - 1/2 cup fresh chives, finely chopped
1 tsp. fresh dill, chopped

_Rice:_

1 cup wild rice
2 cups water
1/4 cup chicken stock
1/4 - 1/2 cup wild rice

_Sauce:_

2 tablespoons horseradish sauce
1 cup mayonnaise
1/2 tsp. anchovy paste
paprika to color

_Garnish:_

large leaves of kale, chard, or similar ornamental lettuce
freshly sliced lemon wedges, de-seeded

diced tomatoes

_Rice:_ Combine cold water, chicken stock and rice. Bring to a boil for five minutes. Remove from heat and let stand covered for twenty minutes. Fluff with fork and chill for at least one hour.

_Salad:_ Remove skin and bones from smoked lake trout. Gently flake the fillets. They should be firm, but delicate. Fold in the cheese, chives, and dill and mix well.

_Sauce:_ Blend the mayonnaise, horseradish, and anchovy paste together well. Add paprika to color.

_Presentation:_ Place whole kale or chard leaves on a flat salad plate. Place 2 tablespoons of chilled wild rice onto the center of the leaf. Place approximately 1 cup of smoked lake trout salad on top of the wild rice, and dust lightly with paprika. Arrange the tomato slices, lemon wedges, and olives around the sides. Place 2-3 tablespoons horseradish sauce on the side. Serve immediately and refrigerate leftovers.

Recipes reprinted with permission from Favorite recipes from the Old Rittenhouse Inn, Bayfield, Wisconsin.
GLIFWC has been testing walleye fillets for mercury content since the early 1990s with a focus on those lakes frequently harvested by member tribes during spring spearing. The past several years of testing has been funded by the Agency for Toxic Substances and Disease Registry (ATSDR) in cooperation with Dr. John Dellinger, senior research scientist at the UW-Milwaukee NEIHS Marine and Freshwater Biomedical Center. Mercury analyses were conducted by the Lake Superior Research Institute at UW-Superior.

In 1999, GLIFWC collected 324 walleye (39 egg, 7 teses samples) from 23 Wisconsin, two Minnesota, and five Michigan lakes. Sampling included adult walleye from five of twelve long-term study lakes monitored at least biennially.

The Wisconsin Department of Health recommends limiting consumption of fish with 0.5 ppm mercury, and no consumption of fish with 1 ppm or more. All walleye from 19 of the 30 lakes tested were below 1.0 ppm, and in six of these lakes all fish were below 0.5 ppm. As provided in a Memorandum of Understanding between GLIFWC and the Wisconsin Department of Natural Resources (WDNR), results from mercury testing are exchanged between the two agencies. GLIFWC then compiles all the data from the WDNR with their own data for the ceded territories. GLIFWC’s data comprises approximately 25 percent of the mercury data on walleye within the ceded territories.

Using this database, GLIFWC produces, and regularly updates, Geographic Information System (GIS) maps that provide a comparison of lakes based on mercury concentrations in walleye. General information regarding methylmercury and the consumption of fish is provided on the back of the map (see page 15).

One project was to investigate whether mercury was evenly distributed throughout the muscle tissue of walleye and muskellunge. If so, then a small section of tissue could be collected for testing rather than the entire fish. Since many of the walleye used for testing are from tribal spearers, using only a small sample would allow fishermen to keep most of the fish.

Six walleye and four muskellunge fillets were cut into 4 and 8 fillet segments, respectively, and each segment as well as the whole fillet was analyzed for mercury. No significant differences (p-value > 0.05) were detected between filament segments or whole fillets. Thus, initial results indicate that it may be a reliable method to just use a small sample of these fish for testing.

Another project was to compare mercury levels in walleye taken from two distant and discrete areas of the Chippewa Flowage. A question raised by some Lac Courte Oreilles tribal members was whether mercury levels might be different depending on where in the Flowage fish were taken. A total of twenty four adult walleye were collected from the Chippewa Flowage, with 12 being collected from the western half of the Flowage and 12 from the eastern half of the Flowage.

No significant differences (p-value > 0.05) were found between the two locations, indicating that the location where fish walleye were collected was not a factor.

Since 1996, GLIFWC has tested 31 perch and 32 walleye from Mille Lacs Lake for mercury content in skin-off fillets. In addition, the Minnesota Department of Natural Resources has tested 10 walleye and 10 northern pike. The data show that these species in Mille Lacs Lake are low in mercury content and safe to eat (see Graph 9).

A tribal fish consumption study started in 1997, will continue for five years. Each year twelve volunteer families from Wisconsin and Minnesota tribes are asked to record the number of meals and the amount of fish consumed per family member per meal over the course of a year. This study is also funded by ATSDR and will end after the 2001/2002 fishing year.

Through the above research, GLIFWC hopes to provide tribal governments and tribal members with the information needed to make decisions about how to avoid the health risks of eating contaminated fish while enjoying the health and cultural benefits of eating fish.
Advice to consider when eating fish

Remember that for many native people giigoonh (fish) are part of a traditional diet and, as such, provide health benefits. However, it is difficult to provide advice as to when the health risks outweigh the health benefits of eating fish.

So if you rely on fish as part of your normal diet, try to achieve a balance. Continue to eat giigoonh but take steps to avoid highly contaminated ones and space meals out.

Look for lakes where the larger ogaa (walleye) have low mercury levels and eat only the smaller ogaa from these lakes; put these smaller ogaa in freezer bags labeled as reserved for children and women of child bearing age.

The other ogaa with mercury levels between 0.5 and 1.0 ppm can be saved for men and elders, but intake of these giigoonh should also be limited. Giigoonh with levels above 1.0 ppm shouldn’t be eaten by anyone.

Mercury: Where it comes from

Mercury is a natural element that is found in air, water, rocks, and soil. Mercury evaporates from these sources and returns to Aki (the earth) attached to small airborne particles or is washed out of the air by rain or snow. Since about 1850 the amount of mercury cycling through Aki has been increasing about 1.7 percent per year due to human activity.

For example, burning coal, wood, and waste (both household and industrial) releases mercury into the atmosphere. An estimated 75% of newly deposited mercury entering Minnesota’s land and lakes comes from human activities; the other 25% is natural.

Efforts are being made to reduce the amount of mercury entering the environment. For example, the White Pine smelter in northern Michigan was the largest source of mercury pollution in the Lake Superior basin and was shut down in 1995. Also, it is no longer legal to use mercury as a fungicide in latex paints.

Mercury: How it gets into giigoonh

When mercury enters lakes and streams, bacteria or chemical reactions transform it into methylmercury. This form of mercury is absorbed by giigoonh as water passes over their gills. All giigoonh probably contain some methylmercury and absorb it throughout their life.

Methylmercury is easily absorbed by animals which eat fish. It builds up in ever increasing amounts as small insects are eaten by small fish, which then are eaten by large fish, which are eaten by Anishinaabe.

For example, water containing two (2) parts per trillion of mercury can build up to 450 parts per billion methylmercury in giigoonh (northern pike), a 225,000-fold increase. So if you rely on fish as part of your normal diet, try to achieve a balance.

Methylmercury can build up in the body gradually and it may take months or years of regularly eating fish to accumulate levels which are a health concern. Small amounts can be safely eliminated.

However, when the amount taken into the body exceeds the amount that can be eliminated, methylmercury builds up. In adults the first signs of poisoning are tremor of the hands and a burning or tingling sensation in the fingers or toes. At higher levels, walking is affected, followed by blurred vision. Severely-affected people have speech and hearing problems. In rare cases of severe exposure, a person can become paralyzed and die.

The fetus is most sensitive to mercury poisoning because its nervous system is developing. However, young children, pregnant and nursing women, and women of childbearing age also need to take extra care.

In the early 1970’s, more than 400 people in Iraq died from eating bread made from wheat treated with methylmercury which was intended for planting. Researchers found that children exposed while in the womb experienced delayed development in walking and talking, even though the mother was not affected.

Concerns expressed by tribal spearers

A 1993 survey of tribal spearers indicated that mercury levels in fish were of concern. Out of 69 people responding to the survey:

- Mercury was a concern to 90% of the respondents.
- Some spearers were modifying their behavior. Over half (64%) avoided spearing lakes where walleye were believed to be unsafe to eat because of high mercury levels. About half (49%) avoided taking a walleye or chose only the “safer to eat” small walleye.
- Assumptions upon which state health advisories are based may not be appropriate for tribal spearers. For example, the Wisconsin Fish Consumption Advisory assumes that the average meal size is eight (8) ounces and that people consume fish uniformly throughout the year. In contrast, tribal spearers reported consuming larger meal sizes and more meals during spring than in other seasons.

Using mercury maps to make informed decisions

#### Map for use by women planning to have children and children under 15 years of age

The map on the top half of the opposite side is based on 0.50 ppm (parts per million) of methylmercury, which is the level used by the Wisconsin Division of Health to give the following advice:

- If mercury levels are below 0.50 ppm, then pregnant women are advised to eat only one meal of fish per month. Children, men, and women who are not pregnant or breastfeeding may eat unlimited amounts of these fish.
- If mercury levels are above 0.50 ppm, then pregnant or breast-feeding women, women who plan to have children, and children under 15 years of age should not eat any of these fish.

#### Map for use by women not planning to have children and by men

The map on the bottom half of the opposite side is based on 1.0 ppm (parts per million) of methylmercury. According to the Wisconsin Division of Health, no one should eat fish with mercury concentrations of 1.0 ppm or more.

Health risks of eating contaminated fish

Methylmercury is neurotoxic; it affects the brain and spinal cord. Methylmercury could build up in the body gradually and it may take months or years of regularly eating fish to accumulate levels which are a health concern. Small amounts can be safely eliminated.

However, when the amount taken into the body exceeds the amount that can be eliminated, methylmercury builds up. In adults the first signs of poisoning are tremor of the hands and a burning or tingling sensation in the fingers or toes. At higher levels, walking is affected, followed by blurred vision. Severely-affected people have speech and hearing problems. In rare cases of severe exposure, a person can become paralyzed and die.

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Masinaigan (Talking Paper) is a quarterly publication of the Great Lakes Indian Fish & Wildlife Commission (GLIFWC), which represents eleven Chippewa tribes in Michigan, Minnesota and Wisconsin.

Weeds, weeds, weeds. Weeds... (unless otherwise noted):