Masinaigan Supplement

Published by the Great Lakes Indian Fish & Wildlife Commission

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
Flashed 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 medicines are strong
Our weapons are worn
Our spirits are glad
Gitche Manito has been kind.

—Excerpted from Ojibway Heritage, by Basil Johnston

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 8 ounce meals of lake trout each month provides 6.0 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 Amoose.)

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.

Tribal entrepreneurs Alan Newago and Gilmore Peterson process whitefish, lake trout, and herring into smoked fish spreads, smoked sausage, and pickled fish products for the enjoyment of area visitors and residents. (Photo by COR.)

- 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.

Contaminants in fish pose different risks for different groups of people

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 2)

Risk related to size and species

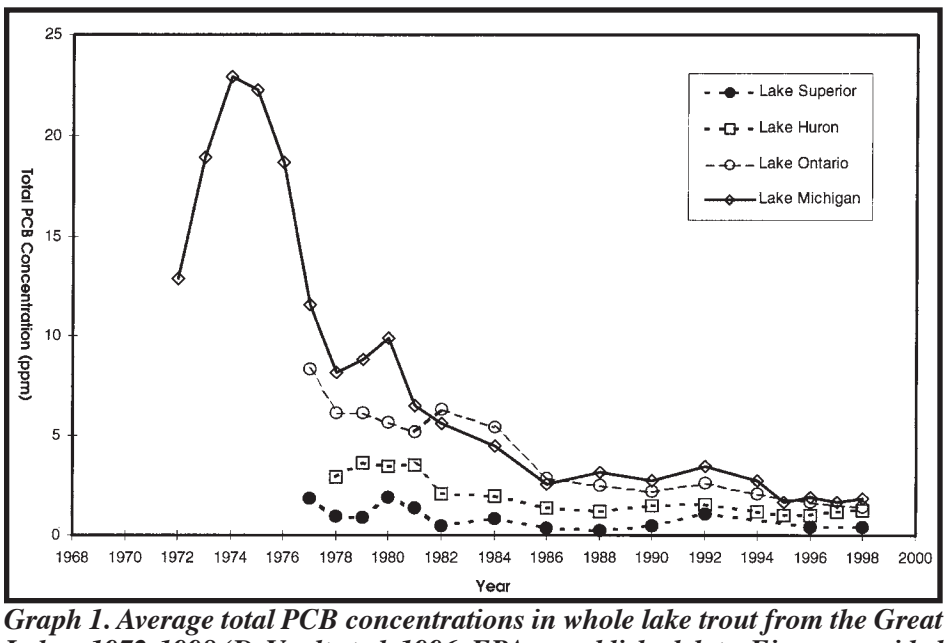
(Continued from page 1)
and child development from PCBs. If you are within this special population, you should carefully select the locations, types, and sizes of fish you plan to eat.

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 methods 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.



Graph 1. Average total PCB concentrations in whole lake trout from the Great Lakes, 1972-1998 (DeVault et al. 1996, EPA unpublished date. Figure provided by Robert Day of the Michigan Department of Environmental Quality.)

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

Lake Superior Fish	Size	PCBs ppm	Methylmercury ppm
Whitefish	22-24	0.0323	0.065
Lake trout	25-26	0.229	0.163
Difference Lake trout v. Whitefish (trimmed off fillets)		7 times greater	2.5 times greater

(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 from 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.

Contaminant level by size

Lake Superior Fish	Size	PCBs ppm	Methylmercury ppm
Whitefish	25-26	0.229	0.163
Lake trout	27-28	0.391	0.355
Difference 25-26 inch size v. 27-28 inch size (trimmed off fillets)		1.71	2.18

(Table 2)

If you eat walleye from inland waters, refer to GLIFWC's Mercury Contamination of Walleye (Ogaa) maps to select the sizes of fish that are below .5 ppm for women and children. Select sizes of fish that are below 1 ppm for men, elders and women beyond child-bearing years.

Trimming Lake Superior fish significantly reduces PCBs and pesticides, but not mercury

While all Lake Superior lake trout, whitefish, and herring samples tested by GLIFWC were below U.S. FDA action limits for chemical contaminants, trimming the fat tissue from fillets and removing the skin from whitefish **reduced PCB levels by 44%**.

Trimming fillets and removing skin from lake trout and siscowet trout also significantly reduced the concentration for PCBs, chlordane, and other organic persistent contaminants (Table 3). The following diagram illustrates how subsistence fishers can trim their fillets to reduce PCBs and pesticides found in Lake Superior fish. (Figure 1). Trimming fillets and removing skin did not reduce mercury concentrations in Lake Superior fish due to mercury being bound to muscle tissue.

Cooking reduces PCBs and pesticides in Lake Superior fish, but not mercury.

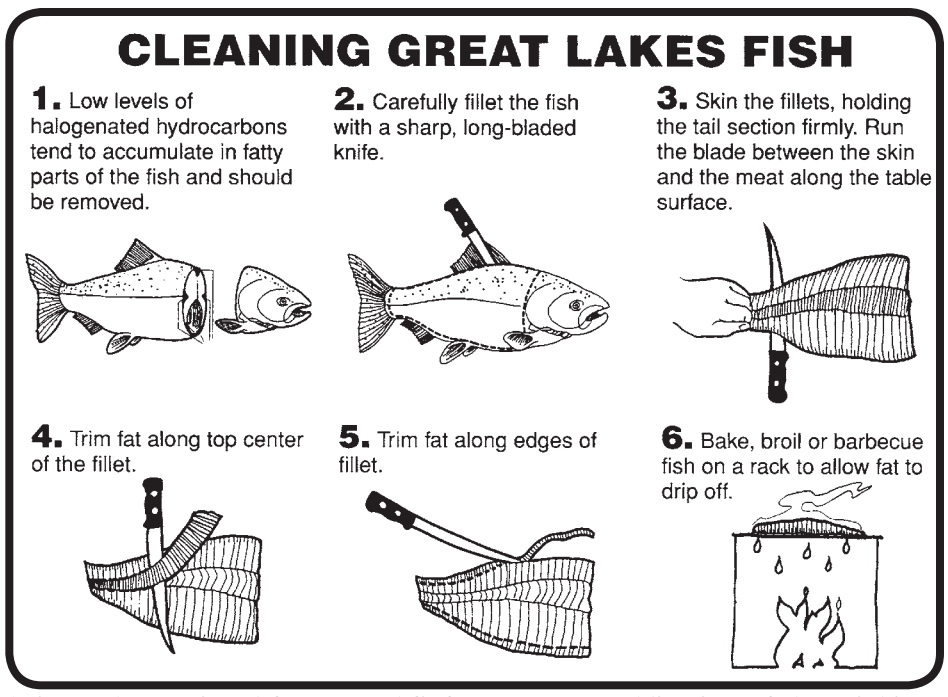
In 1993, Dr. Mary Zabik, Michigan State University, released the results of a study on contaminants in cooked Great Lakes fish. This study examined a variety of cooking methods including baking, charbroiling, charbroiling of scored fillets, deep fat frying, pan frying, salt boiling, smoking, and canning. The results of the study showed that PCBs could be reduced in lake trout by 51% through processing and cooking. The table below was prepared from information presented in Michigan Sea Grant Extension's publication Eating Great Lakes Fish.

Skin-on fillet for a three to seven pound lake trout	100%
PCBs were reduced by trimming fat from the fillet and removing skin	-28%
PCBs were reduced by cooking	-23%
Total Reduction in PCBs (-28% + - 23%)	- 51%
Percent of PCBs remaining in the edible portion	49%

(Table 3)

"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% of contaminants was lost in fish that were scored," Zabik reported in her study.

While Dr. Zabik's study found *"few significant differences in contaminant reduction between various cooking methods,"* the "Michigan 2000 Fish Advisory" recommends that fish containing higher fat content be cooked so the fat drips away. This can be accomplished by baking, broiling, or grilling fillets on a rack to reduce chemical contaminants in the edible portion of the fish. The advisory also recommends against pan-frying fish in butter or animal fat. If fish is to be deep fried, the advisory recommends the use of vegetable oil, and after frying, drain and dispose of the oil. The basis for these recommendations is the belief that PCBs and pesticides are stored in the fat of fish. The higher the fat content of the fish and the greater the known PCBs and pesticide levels, the greater the risks to women of child-bearing years and children.



(Figure 1. Reprinted from Food Safety News, a publication of the Michigan State University Cooperative Extension Service.)

Health benefits of eating fish

The benefits of eating fish, a traditional source of nutrition for the Ojibwe, often becomes obscured by the contemporary focus on contamination.

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?

Modest adjustments to diets of adults that remove high fat food items, and replace the energy with traditional food species of deer, ***walleye, perch, trout,*** *pumpkin and squash would make the average diet meet recommended dietary allowances (RDAs) levels for all nutrients assessed except calcium. The hypothetical average all-traditional diet appears nutritionally adequate in all respects, except calcium.*

Can traditional Ojibwe food be used to improve the well-being 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 and, for some, 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.

In her research, Dr. Kuhnlein cited numerous studies documenting the health benefits of eating fish. **"Traditional cultures using fish and sea mammal food are well-known to consume important quantities of n-3 fatty acids (the omega fats) that protect against cardiovascular disease, certain cancers, and have recently been implicated in diabetes prevention."**

"Traditional cultures using fish and sea mammal food are well-known to consume important quantities of n-3 fatty acids (the omega fats) that protect against cardiovascular disease, certain cancers, and have recently been implicated in diabetes prevention."

—Dr. Harriet V. Kuhnlein, McGill University

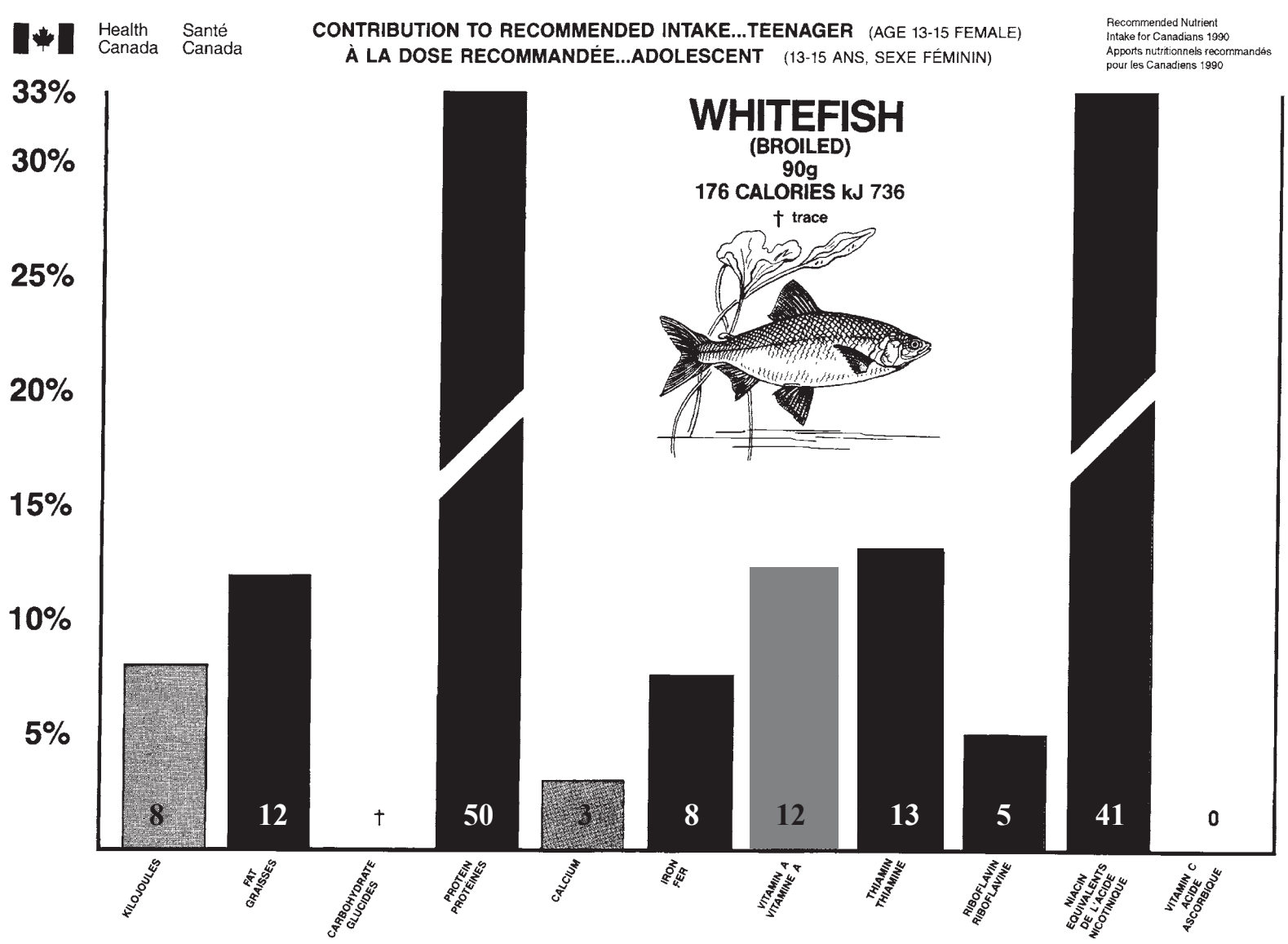
Fish prepared over an open fire—a tasty, tantalizing and nutritious meal—is associated with some of the best time outdoors and is traditionally served at many Ojibwe feasts. (Photo by Amoose.)

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:

- Increase the knowledge of the cultural and nutritional value of native foods in Canada;
- Promote an understanding of the current and potential contribution of native foods to good nutrition and health;
- Provide a better understanding of the effect of changing food habits on nutrition and health,and;
- Help individuals and communities choose native foods wisely, to substitute as needed with non-traditional foods, and to include a greater variety of foods in the diet.



(Graph 2. Reprinted with permission from Nutrient Bar Graphs, Health Canada, © Minister of Public Works and Government Services Canada, 2000.")

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 Graphs enable 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 broken bar. The numbers within

(See Fish, page 4)

Fish continue to be culturally and nutritionally important

(Continued from page 3)
the bar show the percentage of Recommended Nutrient Intake (RNI) provided by various types of the fish. Across the bottom (x-axis) are listed energy (1 calorie = 4.183 kilojoules) and 10 essential nutrients. Table 4 shows the nutritional value of whitefish.

Energy and nutrients	90 gram (3.17 oz) serving of broiled whitefish - percent RNI
Calories	8% (176)
Fat	12 % (10.2 grams)
Protein	50%
Calcium	3%
Iron	8%
Vitamin A	12%
Thamin	13%
Riboflavin	5%
Niacin	41%

(Table 4)

Numerous scientific studies have documented the health benefits of eating fish

Clearly, fish have been, and continue to be, a culturally and nutritionally important source of low fat, high protein food for the Ojibwe. Science continues to confirm the benefits of regularly eating fish (1-2 meal per week). Research has shown that fish is a good source of high-quality protein, essential fatty acids, and minerals such as iron and zinc which are important in the diets of children. Pregnant mothers who regularly consumed fish were found to have longer gestational periods and heavier birth-weight babies, which has been associated with healthier children.**

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.).

Bad River youth proudly display their catch after a night of spearing with the T.R.A.I.L.S. program. Fishing practices ad the custom of eating fish are important Ojibwe traditions to be preserved. (Photo by Amoose.)

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 a 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.

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 (see Table 5).

Lake Superior Fish Species	Total Beneficial Fatty Acids (100 grams or ~8 oz serving of muscle tissue)	No. 8 oz Meals/Month to Achieve 5.5 grams of Omega-3 FA related to 50% reduction in death due to CDH.
Lake Herring	2.2 grams	2.5
Smelt	1.0 grams	5.5
Lake Whitefish	3.2 grams	1.7
Burbot	0.4 grams	14
Lake Trout	3.0 grams	1.8
Siscowet Trout	6.0 grams	0.9

(Table 5)

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.

While all Lake Superior whitefish, lake trout, and herring samples tested by GLIFWC are below U.S. FDA action limits for chemical contaminants, trimming the fat tissue from fillets and removing the skin from whitefish reduced PCB levels by 44%. The diagram on page two shows how subsistence fishers can trim their fillets to reduce PCBs and pesticidees found in Lake Superior fish. (Staff photo)

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.

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.

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.

Tribally licensed commercial fishermen assisted GLIFWC in collecting 431 fish samples for contaminant testing during numerous Lake Superior assessments. Above are fisheries biologists Sean Sitar, MIDNR, and Bill Mattes, GLIFWC, working aboard Gilmore Peterson's fishing tug. (Photo by Sue Erickson.)

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.

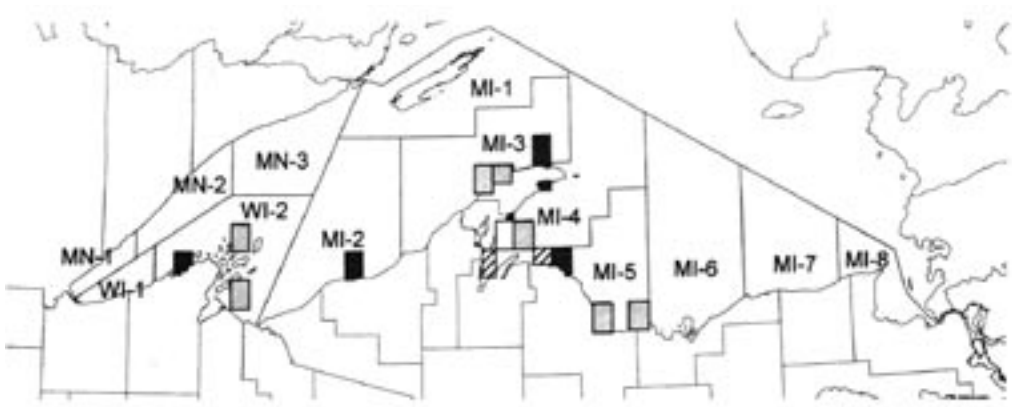
Common Name	SizeNo. Range (in)	No. Composites (C)	Total No. Fish/C	Fish
siscowet	17.0-18.0	4	12	48
siscowet	19.5-20.5	4	12	48
siscowet	22.0-23.0	4	12	48
siscowet	24.5-25.5	4	12	48
siscowet	24.5-25.5	4	12	48
lake trout	25.0-26.0	4	12	48
lake trout	27.0-28.0	4	12	48
lake trout	27.0-28.0	3	8	24
whitefish	22.0-24.0	4	12	48
lake herring	15.0-17.0	4	12	48

(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-HAACP contaminant analysis during 1998 and 1999



Species collected in area

Lake Trout | Siscowet Trout | Whitefish | Lake Herring

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 four (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 twelve 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 (composited) 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.

Sampled Lake Superior fish below FDA restrictions for both PCBs and chlordane

Continued from page 5)

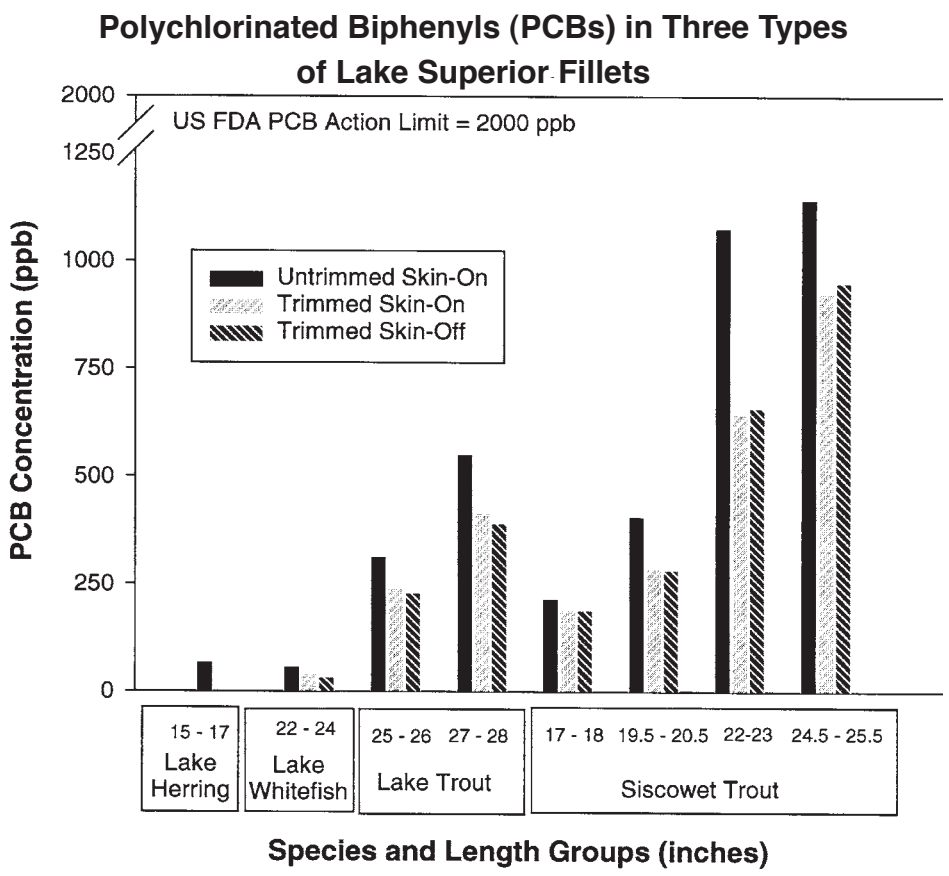
Joe Duffy, Red Cliff commercial fisherman, (left) assisted by Ben Pfaff, University of Wisconsin-Superior student, processes fish samples for contaminant testing at the Lake Superior Research Institute, UW-Superior. (Photo by Charlie Otto Rasmussen.)

Testing Lake Superior fish samples

Each composite sample was analyzed for total mercury, polychlorinated biphenyls 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 for PCBs of 2000 ppb (2.0 ppm).
- Trimming fillets lead to reduced PCB contaminant levels by 12% to 40% depending on the fish species. For example, PCB contaminant levels in whitefish were reduced 32% and in lake trout 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.)



(Graph 3)

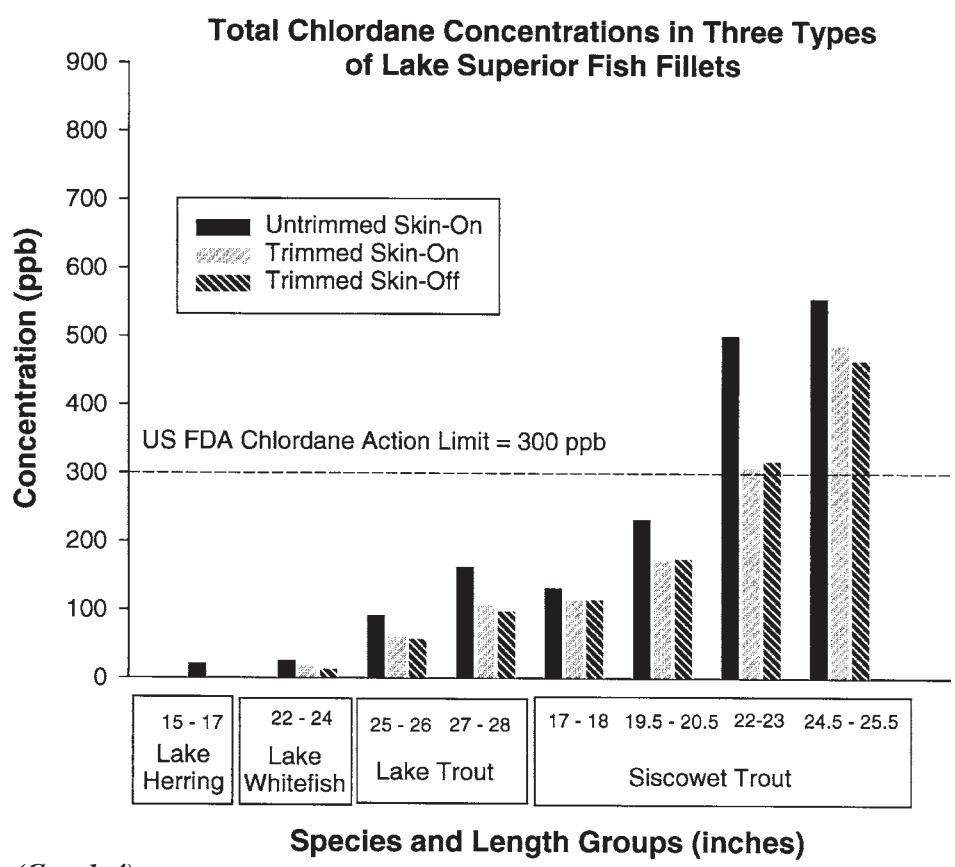
Length Group *Inches*	Processing[a] *Fillets*	Age (Range) *years*	Processing Reduction *Percentage*	Total Polychlorinated Biphenyls *Mean*	*Lower*	*Upper*	Exceeds US FDA Action Limit
Lake Herring (Total = 48 fish [4 composites x 12 fish])							
15.0-17.0	UT S-ON	9 (7 to 13)		68	61	75	No
Lake Whitefish (Total = 47 fish [4 composites x 11 to 12 fish])							
22.0-24.0	UT S-ON	9 (7 to 12)		58	49	67	No
22.0-24.0	T S-ON		32%	39	28	51	No
22.0-24.0	T S-OFF		44%	32	20	45	No
Lake Trout (Total = 128 fish [12 composites x 7 to 12 fish])							
25.0-26.0	UT S-ON	9 (6 to14)		313	244	382	No
25.0-26.0	T S-ON		23%	241	186	297	No
25.0-26.0	T S-OFF		27%	229	178	280	No
27.0-28.0	UT S-ON	10 (6 to 16)		551	378	724	No
27.0-28.0	T S-ON		25%	415	279	551	No
27.0-28.0	T S-OFF		29%	391	274	509	No
Siscowet Trout (Total = 208 fish [22 composites x 4 to 12 fish])							
17.0-18.0	UT S-ON	13 (10 to 17)		216	177	255	No
17.0-18.0	T S-ON		12%	190	152	227	No
17.0-18.0	T S-OFF		13%	189	151	226	No
19.5-20.5	UT S-ON	15 (9 to 20)		407	326	487	No
19.5-20.5	T S-ON		30%	286	249	324	No
19.5-20.5	T S-OFF		31%	283	260	305	No
22.0-23.0	UT S-ON	16 (11 to 24)		1078	422	1734	No
22.0-23.0	T S-ON		40%	647	375	919	No
22.0-23.0	T S-OFF		39%	660	383	937	No
24.5-25.5	UT S-ON	18 (15 to 23)		1145	890	1401	No
24.5-25.5	T S-ON		19%	926	780	1071	No
24.5-25.5	T S-OFF		17%	952	802	1101	No

[a]: UT S-ON = Untrimmed Skin-On; T S-ON = Trimmed Skin-On; T S-OFF = Trimmed Skin-Off

(Table 7)

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 **did** exceed 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.)



(Graph 4)

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 fillet.** (Note: see Total Chlordane Concentrations in Untrimmed and Trimmed Skin-on Siscowet Fillets from the South Shore of Lake Superior, Graph 5, page 7)

(See Lake Superior fish, page 7)

Lake Superior fish are tested for mercury

(Continued from page 6)

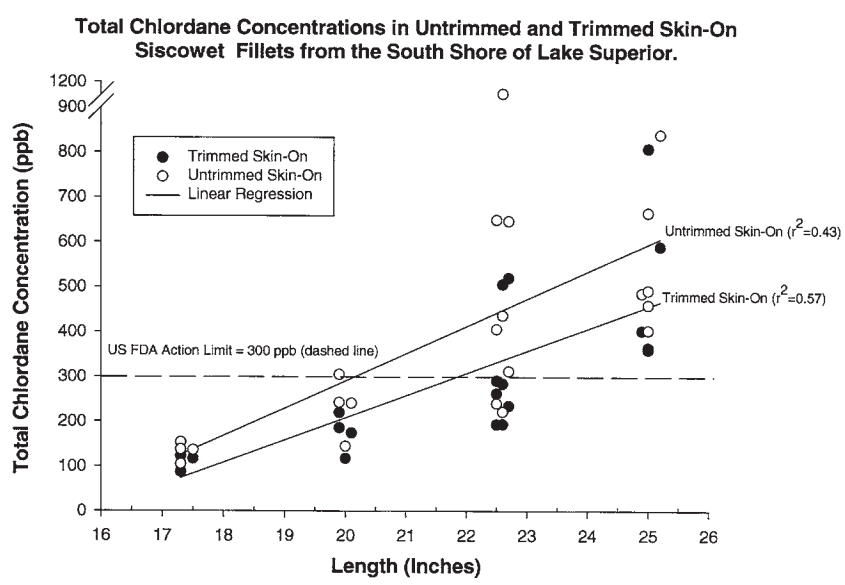
Mercury findings

- None of the Lake Superior fish samples (lake herring, whitefish, lake trout, or siscowet trout) exceed the U.S. FDA's methylmercury action limit for commercial sales of 1000 ppb (1.0 ppm).
- Only siscowet samples in the 22-23 inch size group and 24.5-25.5 inch size group exceeded 500 ppb (.5 ppm), a lower level used by Michigan for fish caught and sold in that state.

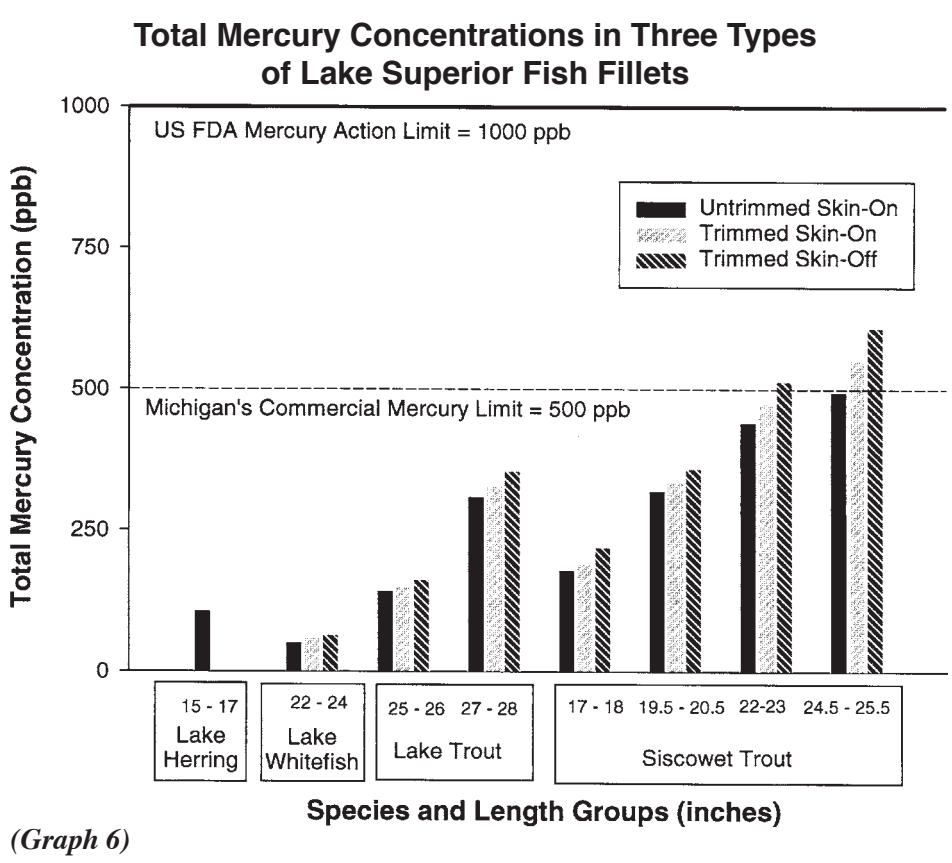
Length Group *Inches*	Processing[a] *Fillets*	Age (Range) *years*	Processing Reduction *Percentage*	Total Chlordane *Mean*	*Lower*	*Upper*	Exceeds US FDA Action Limit
Lake Herring (Total = 48 fish [4 composites x 12 fish])							
15.0-17.0	UT S-ON	9 (7 to 13)		22	21	23	No
Lake Whitefish (Total = 47 fish [4 composites x 11 to 12 fish])							
22.0-24.0	UT S-ON	9 (7 to 12)		26	25	28	No
22.0-24.0	T S-ON		33%	18	15	21	No
22.0-24.0	T S-OFF		47%	14	11	17	No
Lake Trout (Total = 128 fish [12 composites x 7 to 12 fish])							
25.0-26.0	UT S-ON	9 (6 to14)		93	71	115	No
25.0-26.0	T S-ON		34%	61	46	76	No
25.0-26.0	T S-OFF		38%	58	43	72	No
27.0-28.0	UT S-ON	10 (6 to 16)		164	119	210	No
27.0-28.0	T S-ON		34%	108	75	141	No
27.0-28.0	T S-OFF		40%	99	72	127	No
Siscowet Trout (Total = 208 fish [22 composites x 4 to 12 fish])							
17.0-18.0	UT S-ON	13 (10 to 17)		133	112	153	No
17.0-18.0	T S-ON		13%	116	95	137	No
17.0-18.0	T S-OFF		13%	116	94	137	No
19.5-20.5	UT S-ON	15 (9 to 20)		233	167	299	No
19.5-20.5	T S-ON		25%	174	131	216	No
19.5-20.5	T S-OFF		24%	176	131	220	No
22.0-23.0	UT S-ON	16 (11 to 24)		502	207	797	Yes
22.0-23.0	T S-ON		38%	310	180	440	Yes
22.0-23.0	T S-OFF		36%	319	186	452	Yes
24.5-25.5	UT S-ON	18 (15 to 23)		557	393	721	Yes
24.5-25.5	T S-ON		12%	488	309	666	Yes
24.5-25.5	T S-OFF		16%	466	353	579	Yes

[a]: UT S-ON = Untrimmed Skin-On; T S-ON = Trimmed Skin-On; T S-OFF = Trimmed Skin-Off

(Table 8)



(Graph 5. Trimming 22 inch siscowet fillets (closed circles) reduced the estimated average total chlordane concentrations from around 420 ppb to at or below 300 ppb, and thus allowed 22 inch siscowet to be at or below the U.S. FDA's no-sale action limit (300 ppb).)

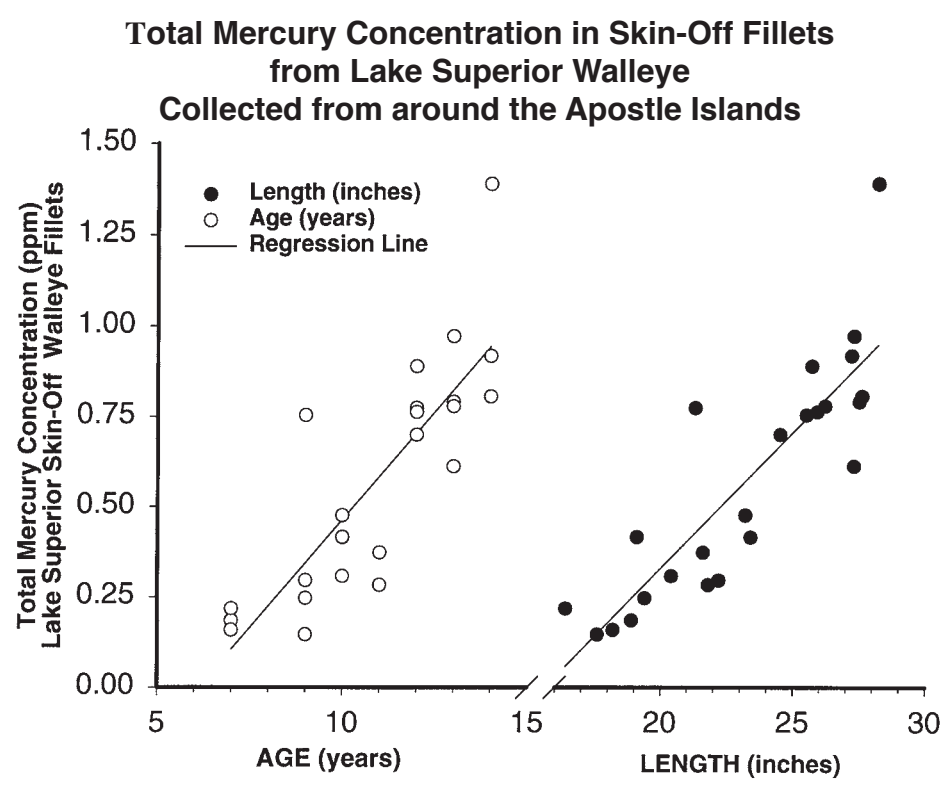


(Graph 6)

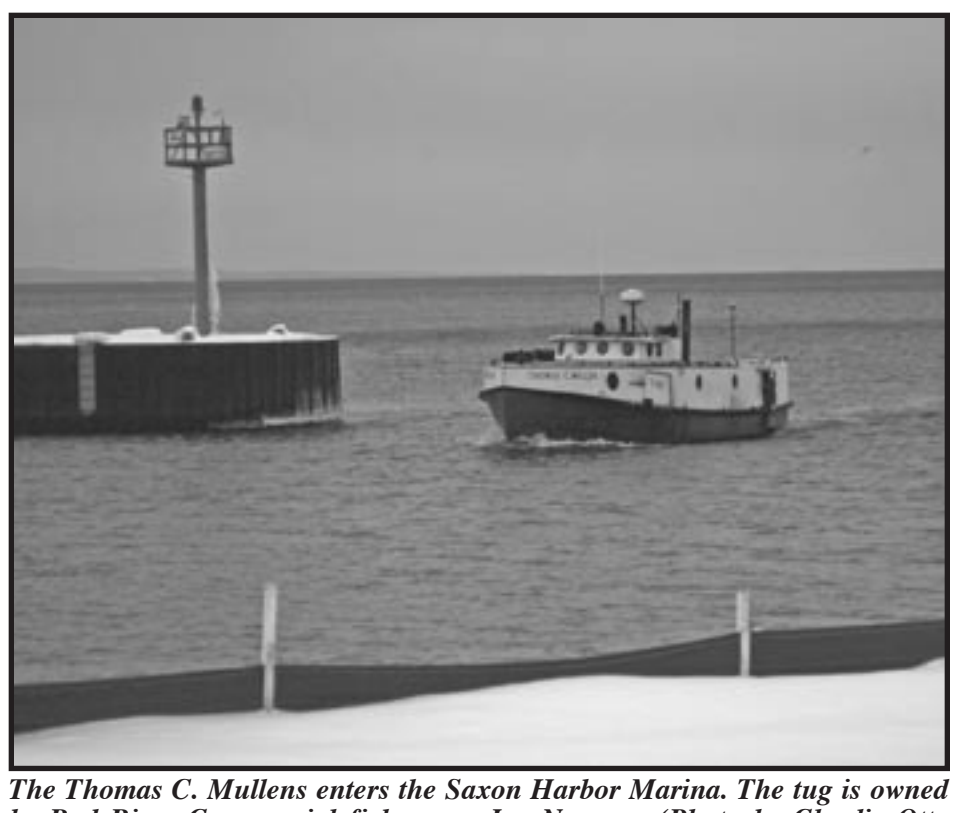
Length Group *Inches*	Processing[a] *Fillets*	Age (Range) *years*	Total Mercury *Mean*	*Lower*	*Upper*	Exceeds US FDA Action Limit
Lake Herring (Total = 48 fish [4 composites x 12 fish])						
15.0-17.0	UT S-ON	9 (7 to 13)	107	65	149	No
Lake Whitefish (Total = 47 fish [4 composites x 11 to 12 fish])						
22.0-24.0	UT S-ON	9 (7 to 12)	51	44	58	No
22.0-24.0	T S-ON		61	52	70	No
22.0-24.0	T S-OFF		65	60	70	No
Lake Trout (Total = 128 fish [12 composites x 7 to 12 fish])						
25.0-26.0	UT S-ON	9 (6 to14)	143	115	171	No
25.0-26.0	T S-ON		150	122	179	No
25.0-26.0	T S-OFF		163	133	193	No
27.0-28.0	UT S-ON	10 (6 to 16)	310	204	415	No
27.0-28.0	T S-ON		328	211	446	No
27.0-28.0	T S-OFF		355	227	484	No
Siscowet Trout (Total = 208 fish [22 composites x 4 to 12 fish])						
17.0-18.0	UT S-ON	13 (10 to 17)	179	148	210	No
17.0-18.0	T S-ON		190	158	221	No
17.0-18.0	T S-OFF		220	186	255	No
19.5-20.5	UT S-ON	15 (9 to 20)	320	265	376	No
19.5-20.5	T S-ON		335	277	393	No
19.5-20.5	T S-OFF		360	301	418	No
22.0-23.0	UT S-ON	16 (11 to 24)	441	345	536	No
22.0-23.0	T S-ON		476	360	592	No
22.0-23.0	T S-OFF		515	396	633	No
24.5-25.5	UT S-ON	18 (15 to 23)	496	437	556	No
24.5-25.5	T S-ON		554	486	621	No
24.5-25.5	T S-OFF		610	535	684	No

a :UT S-ON =Untrimmed Skin-On; T S-ON =Trimmed Skin-On; T S-OFF =Trimmed Skin-Off

(Table 9)



(Graph 7. Twenty-four walleye (16-28 inches) were collected from around Lake Superior's Apostle Islands and only one of the largest walleye (28 inches) of the 24 collected exceeded the U.S. FDAs 1.0 methylmercury action limit.)



The Thomas C. Mullens enters the Saxon Harbor Marina. The tug is owned by Bad River Commercial fisherman Joe Newago. (Photo by Charlie Otto Rasmussen.)

(See Testing reveals good news, page 11)

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).

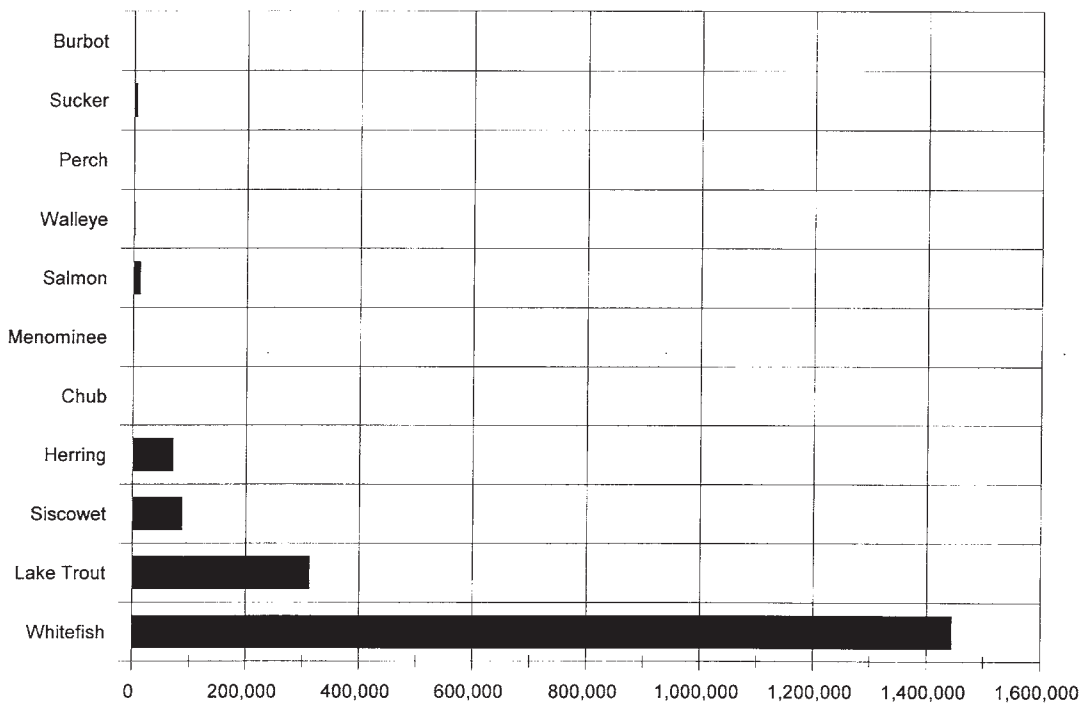
Lake Superior tribal harvest (in round pounds)

Species	1999	1998
Whitefish	1,444,904	1,749,784
Lake Trout	312,723	304,790
Siscowet	87,043	117,501
Herring	71,169	87,971

(Table 10. Data from extractions report file.)

Ron Kinnunen, MSU Sea Grant, demonstrates calibration techniques during a HACCP training session at Red Cliff to Mark Duffy, Red Cliff; Fred Dakota, Keweenaw Bay; Dick Gurnoe, Red Cliff; and Larry Deragon, Red Cliff. (Photo by Sharon Nelis)

Tribal commercial harvest in 1999
U.S. waters of Lake Superior



(Graph 8)

Fred Dakota, Keweenaw Bay, and Joe Duffy, Red Cliff, were two of the participants in a HACCP training program to improve seafood safety and quality control for Lake Superior fish products. Each participant in the three day session at Red Cliff received a certificate from the Association of Food and Drug Officials. (Photo by Sue Erickson)

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 chlordane 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 8)

Tribal fishermen complete HACCP training to improve the safety and quality of Lake Superior fish

With 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 40sh 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.

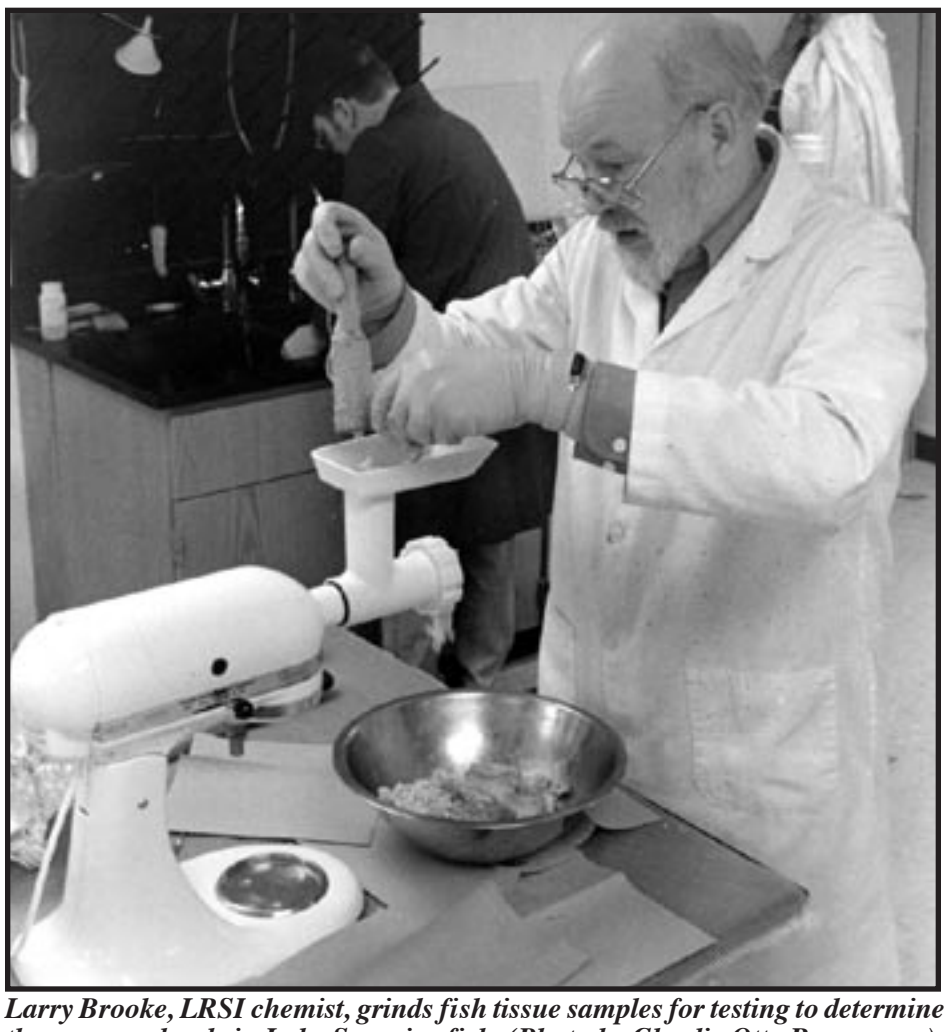
FDA Partnership Agreements for the 1842 waters of Lake Superior

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.



Larry Brooke, LRSI chemist, grinds fish tissue samples for testing to determine the mercury levels in Lake Superior fish. (Photo by Charlie Otto Rasmussen)

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

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, & Cecil 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 Polkinghorne, 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 Kmiecik, GLIFWC Biological Services Director
- Rick Madsen, GLIFWC Data Analyst
- Jennifer Krueger, 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

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 blemishes, or is covered with sticky, yellowish brown mucus.
- When buying steaks or filets, look for moist flesh 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.
- 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's a potential health hazard from cross-contamination—the 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 spoilage.
- 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.

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

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 flesh taken from bruised fish 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 bacteria growth and enzyme activity;
- Flushing away 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 determined that the flushing action of melting ice extended the shelf life of fish in coolers by controling bacterial growth.

Controlling bacteria at your fish cleaning location

It is important to clean all surfaces that come into contact with fish, including coolers/fish boxes, slickers/rain gear, knives, and cutting 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 one 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.

*(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.)*

Storage times at 0° F
Maximum quality

Kind of fish	Tastes like fresh	Maximum storage
FAT— salmon, lake trout, rainbow trout, chubs, whitefish, smelt, lake herring, carp, catfish	3 months	9 months
LEAN— northern pike, suckers, bluegills, bass, crappies and sunfish, walleye and yellow perch	6 months	12 months
SMOKED		2 months

(Table 11. Reprinted from Freshwater Fish Preservation by the Michigan Sea Grant College Program, North Central Regional Publication 498, November 1994.)

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.

- Only freeze the finest quality fish. Fish quality deteriorates rapidly, the longer you wait to freeze freshwater fish the poorer the quality. In a short time the connective tissue in the muscle becomes soft and causes gaping. This allows the flesh to dry out and loose juices.
- Freezing effects quality—poor quality results from freezing fish slowly. Slowly freezing fish causes relatively large ice crystals to form. This destroys the fish's texture and taste. To prevent this problem, freeze fillets individually or in thin boxes—small objects freeze faster.
- Freezer burn is caused by dehydration. Prevent freezer burn by tightly packaging fish so moisture is not lost during frozen storage.
- Fish need to be properly packaged to prevent freezer burn, fat oxidation, or cross-contamination. PVC and polyester are commonly used to freeze fish. Vacuum packing is becoming more popular as prices have come down in recent years. While wax paper and cartons have been traditionally used by the fishery industry, they allow the passage of air and moisture.
- Each lot of fish should be labeled with the lot number and date to insure that frozen fish is turned over on a first-in, first-out basis. Those fishing for subsistence purposes should also refer to GLIFWC's contaminant information to determine the chemical contaminant levels in fish to be frozen and label selected bags as, "reserved for children and women of child bearing age," to minimize exposure to individuals in sensitive populations.

(See Freezing freshwater fish, page 11)

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 canning).

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.

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, Michgan. (Photo by Jim Thannum.)

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 submersing 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.

Testing reveals good news on Lake Superior fish contaminant levels

(Continued from page 7)

Benzene hexachloride, DDT, aldrin/dieldrin, mirex, and heptachlor/heptachlor epoxide findings

- 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 chemical contaminants. (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.)

Chemical	FDA Action Level (ppb)	Lake Herring (15-17 in.) n = 4 Mean (Range)	Lake Whitefish (22-24 in.) n = 4 Mean (Range)	Lake Trout (25-26 in.) n = 4 Mean (Range)	Lake Trout (27-28 in) n = 8 Mean (Range)	Siscowet Trout (22-23 in.) n = 8 Mean (Range)	Siscowet Trout (24.5-25.5 in.) n = 6 Mean (Range)
Benzene hexachloride	300	0 (0-0)	1.5 (0-7.0)	6.2 (5.4-7.3)	5.8 (4.7-8.1)	4.4 (1.6-6.9)	12 (10-18)
DDT & metabolites	5000	3.8 (0-20)	4.8 (0-30)	130 (85-170)	230 (150-380)	630 (260-1300)	680 (470-1000)
Aldrin/Dieldrin	300	7.2 (0-9.6)	0 (0-0)	26 (23-32)	35 (28-48)	79 (32-130)	78 (60-120)
Heptachlor/ Heptachlor epoxide	300	0 (0-0)	10 (3.4-15)	5.9 (5.4-6.3)	6.8 (5.7-8.6)	12 (2.3-26)	12 (8.5-20)
Mirex	100	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	7.8 (0-27)	17 (10-38)

(Table 12. n = number of composite samples each containing 7 to 13 fish.)

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 take trout collected from commercial catches in the Whitefish Bay area (MI-8) recently tested well below state and federal guidelines.

Contaminant levels of the 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 commercially caught fish. Results from an 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 animal 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.

Tribal retail & wholesale outlets

Eastern Lake Superior region

Clear Water Cooperative
Jamie Massy
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

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

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

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.)

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

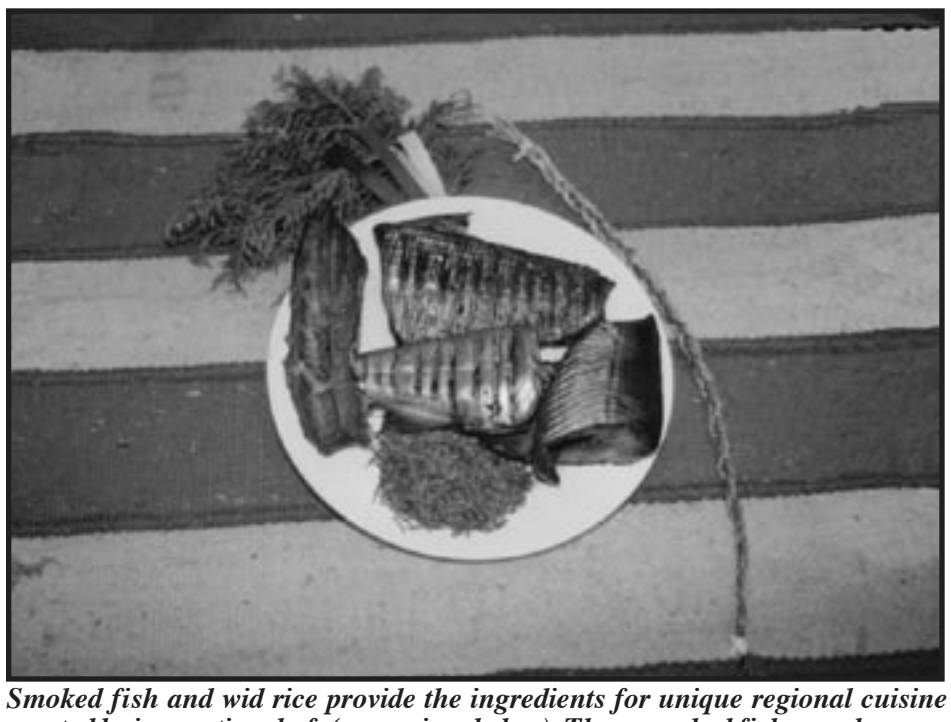
Brad Dakota, Keweenaw Bay tribal member and commercial fisherman, is the owner of Keweenaw Bay Fisheries. The shop features fresh Lake Superior fish, including lake trout and whitefish. (Photo by Jim Thannum)

Commercial tugs 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 is known for his custom smoked fish throughout the L'Anse and Baraga area of Michigan. (Photo by Jim Thannum.)

Ralph Wilcox, Brimley, Michigan, (left) and Ron Kinnunen, MSU Sea Grant, (right) inspect fish samples smoked for GLIFWC during experiments undertaken to assess reductions in chemical contaminants. In addition to smoked fish products, Wilcox Fishery operates a restaurant serving fresh Lake Superior fish. (Photo by Charlie Otto Rasmussen.)

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



Smoked fish and wid rice provide the ingredients for unique regional cuisine created by innovative chefs (see recipes below). These smoked fish samples were prepared by tribal fishermen Joe Dowd, Keweenaw Bay; Alan Newago, Red Cliff; and Gilmore Peterson, Red Cliff. (Photo by Charlie Otto Rasmussen.)

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.

Recipes reprinted with permission from Favorite recipes from the Old Rittenhouse Inn, Bayfield, Wisconsin.

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

Sauce:

2 tablespoons horseradish
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
tomatoe slices

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.

Maps show mercury levels in lakes used by spearers

GLIFWC has been testing walleye fillets for mercury content since the early 1990's 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 NIEHS Marine and Freshwater Biomedical Center. Mercury analyses were conducted by the Lake Superior Research Institute at UW-Superior.

In 1999, GLIFWC collected walleye (329 fillets, 39 egg, 7 testes 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.

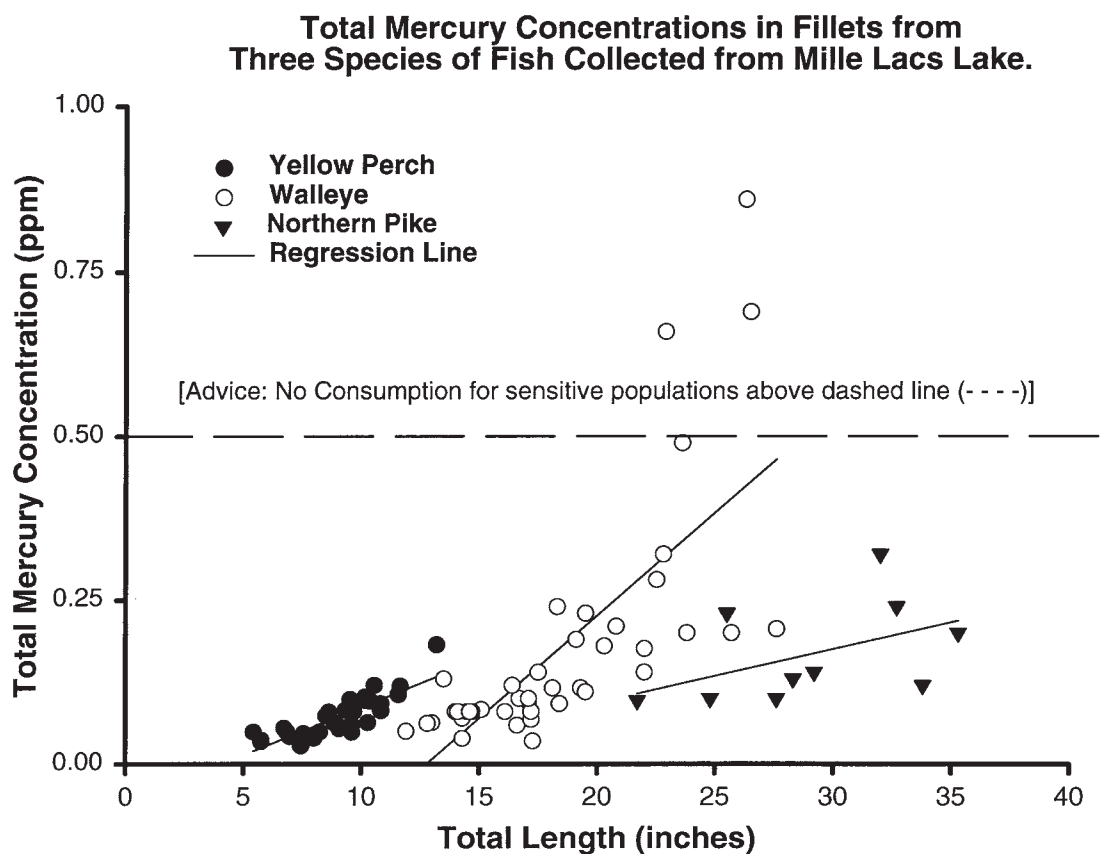
The Wisconsin Department of Health recommends limiting consumption of fish with 0.5 ppm mercury, and no consumption of fish with 1 ppm or more. All walleye from 19 of the 30 lakes tested were below 1.0 ppm, and in six of these lakes all fish were below 0.5 ppm.

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 fillet 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.



Graph 9. Mercury concentrations in three species of fish (walleye, northern pike, yellow perch) from Mille Lacs Lake show that women of childbearing age and young children could safely consume all sizes of all three species tested except walleye over 22 inches.

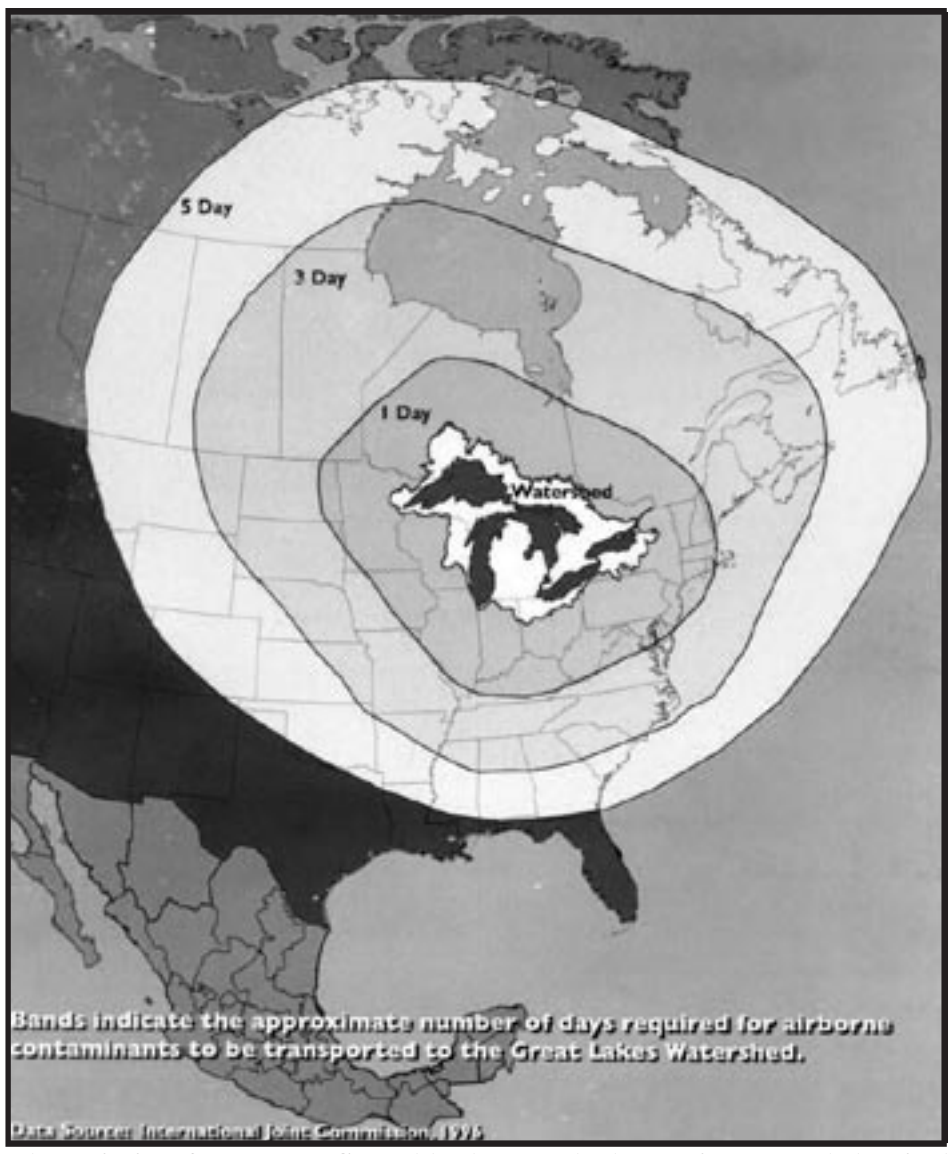
Another project was to compare mercury levels in walleye taken from two distant and discrete areas of the Chippewa Flowage. A question raised by some Lac Courte Oreilles tribal members was whether mercury levels might be different depending on where in the Flowage fish were taken. A total of twenty four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



The majority of mercury, PCBs, chlordane, and other environmental chemical contaminants that enter the Lake Superior watershed are from the air. Contaminants released from the southern most portions of the U.S. and northern most portion of Canada can reach the Great Lakes in under a week. (Reprinted from the International Joint Commission.)

Steve White, GLIFWC environmental aide, filleted walleye and collected dorsal spines for aging while Kory Groetsch, GLIFWC environmental biologist, recorded the length data and packed the samples for shipment to the Lake Superior Research Institute where mercury testing was conducted. (Photo by Charlie Otto Rasmussen.)

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 ginoozhe (northern pike), a 225,000-fold increase. So larger, older, and predatory fish like ogaa (walleye) and ginoozhe will have higher levels of methylmercury than smaller, younger fish such as agwadaashi (sunfish). Mercury is tightly bound in fish tissue and can't be removed by any special cooking or cleaning method.

Kory Groetsch, GLIFWC environmental biologist, shows maps comparing mercury concentration in skin-off walleye fillets from speared lakes are available to tribal members at tribal permit stations and tribal health clinics. (Photo by Sue Erickson)

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 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.

Supplement credits:

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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.*

Subscriptions to the paper are free. To be added to the subscription list, or receive additional copies of this supplement write: Masinaigan, P.O. Box 9, Odanah, Wisconsin 54861 or e-mail pio@glifwc.org. This supplement will also be available from GLIFWC's website at: www.glifwc.org.

Mercury contamination of ogaa in lakes harvested by Bad River