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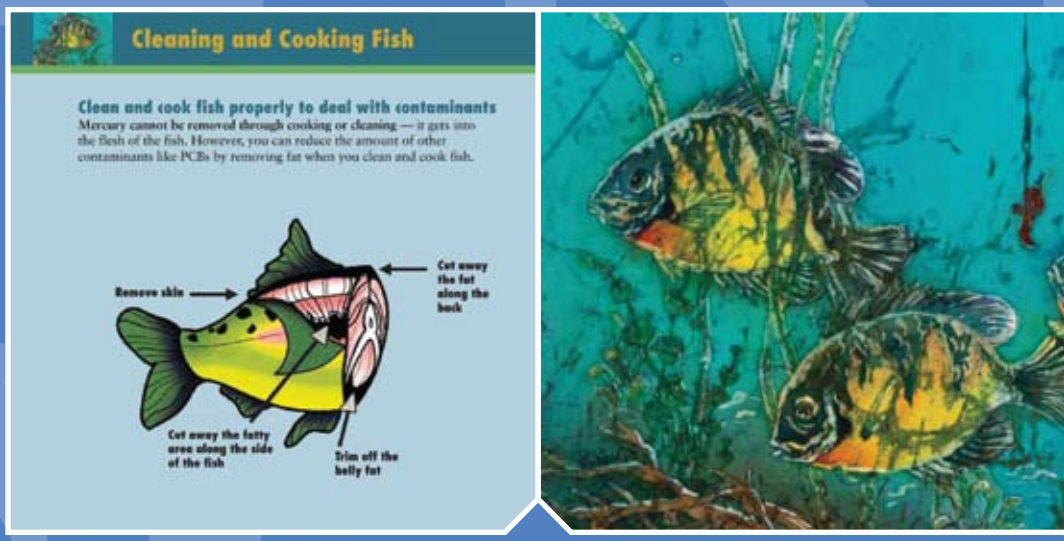
United States
Environmental Protection
Agency

Risk Communication in Action

CASE STUDIES IN FISH ADVISORIES



Office of Research and Development
National Risk Management Research Laboratory

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Risk Communication in Action:

Case Studies in Fish Advisories

by

Science Applications International Corporation (SAIC)
Engineering and Environmental Management Group
Reston, Virginia 20190

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Notice

This document has been reviewed by the U.S. Environmental Protection Agency (EPA) and approved for publication. The mention of any trade name does not constitute endorsement.

Foreword

The U.S. Environmental Protection Agency is charged by Congress with protecting the nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory (NRMRL) is the Agency's center for investigation of technological and management approaches for preventing and reducing risks from pollution that threaten human health and the environment. The focus of the Laboratory's research program is on methods, and their cost-effectiveness, for prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites, sediments, and groundwater; prevention and control of indoor air pollution; and restoration of ecosystems. NRMRL collaborates with both public and private sector partners to foster technologies that reduce the cost of compliance and to anticipate emerging problems. NRMRL's research provides solutions to environmental problems by developing and promoting technologies that protect and improve the environment; advancing scientific and engineering information to support regulatory and policy decisions; and providing technical support and information transfer to ensure implementation of environmental regulations and strategies at the national, state, and community levels.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

Sally Gutierrez, Director
National Risk Management Research Laboratory

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List of Acronyms

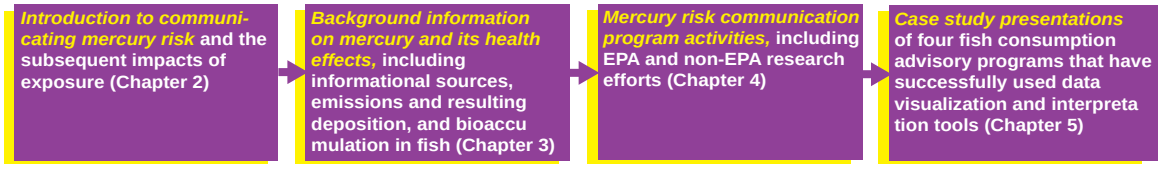
ACME	Aquatic Cycling of Mercury in the Everglades
ADA	American Dental Association
ATSDR	Agency for Toxic Substances and Disease Registry
AVS	acid-volatile sulfide
BMD	benchmark dose
CAA	Clean Air Act
Cal/EPA	California Environmental Protection Agency
CDC	Centers for Disease Control and Prevention
CDHS	California Department of Health Services
CL	confidence level
CNS	central nervous system
CRST	Cheyenne River Sioux Tribe
CWA	Clean Water Act
DDT	dichlorodiphenyl trichloroethane
DEP	Department of Environmental Protection
DFO	Department of Fisheries and Oceans
DNR	Department of Natural Resources
DOC	dissolved organic carbon
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of Interior
EPA	Environmental Protection Agency
ESD	Environmental Sciences Division
FCA	Fish Consumption Advisory
FDA	Food and Drug Administration
FGD	flue gas desulfurization
GLIFWC	Great Lakes Indian Fish and Wildlife Commission
Hg	mercury
IMERC	Interstate Mercury Education and Reduction Clearinghouse
IOMC	Inter-Organization Programme for the Sound Management of Chemicals
KIHD	Kuopio Ischaemic Heart Disease
LOAEL	lowest observed-adverse-effect level
LOD	limit of detection
LOI	loss on ignition
MCL	maximum contaminant level

MCM	Mercury Cycling Model
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
NAAQS	National Ambient Air Quality Standards
NARAP	North American Regional Action Plan
NAS	National Academy of Sciences
NCER	National Center for Environmental Research
NEWMOA	Northeast Waste Management Officials' Association
NERL	National Exposure Research Laboratory
NHANES	National Health and Nutrition Examination Survey
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
NLFWA	National Listing of Fish and Wildlife Advisories
NOAEL	no observed-adverse-effect level
NRC	National Research Council
NRC	Nuclear Regulatory Commission
NRMRL	National Risk Management Research Laboratory
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OEHHA	Office of Environmental Health Hazard Assessment
OERR	Office of Emergency and Remedial Response
ORD	Office of Research and Development
OSHA	Occupational Safety and Health Administration
PBT	persistent, bioaccumulative, and toxic
PCB	polychlorinated biphenyl
PM	particulate matter
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
SETAC	Society of Environmental Toxicology and Chemistry
SFWMD	South Florida Water Management District
SOx	sulfur oxides
SRI	Science Results Integration
STAR	Science to Achieve Results
UNEP	United Nations Environment Programme
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WCS	Watershed Characterization System
WIC	Women, Infants, and Children

1.0 How to Use this Handbook

This handbook provides both general and detailed information on how to enhance mercury risk communication activities and other outreach efforts and to facilitate communication in areas where information is not available.

1.1 Road Map



1.2 Frequently Asked Questions

The following are answers to frequently asked questions that should be considered when developing or expanding a mercury risk communication program.

1.2.1 Risk Communication Concerns

How do data visualization and data interpretation tools communicate risk?

Data visualization tools present information through images (such as maps, icons, and pie charts) rather than words. Tools used to interpret data (such as indexes) describe complex scientific concepts in relatively simple terms. Both of these tools can be particularly powerful in relaying information about environmental quality conditions and environmental health risks. Figure 1-1 was taken from the EPA report "Evaluation of Mercury Risk Communication Messages," which evaluated the way in which people digest mercury risk information.

What is time-relevant risk communication?

The term "time-relevant" refers to the goal of providing real-time (such as daily or near-daily) environmental information. Providing time-relevant information can be particularly important when one seeks to communicate environmental risks, because such risks depend on conditions that can change each day. The Internet and other data visualization and interpretation tools often make it possible to communicate environmental risk information fairly quickly.

What are some of the most effective ways to inform the public about environmental risks?

According to the experience of previous environmental risk communication projects, the most effective ways to relay environmental risk information is to establish a web site that displays a variety of tools for showing data (e.g., maps, color-coded charts), arranging for local news media to present your information, establishing a telephone hotline, and developing a collection of printed materials. Many other outreach methods may also be effective, such as setting up kiosks at strategic locations to distribute information (sometimes on on-site computers), giving presentations to local officials and others, and incorporating the information into school science curriculums.

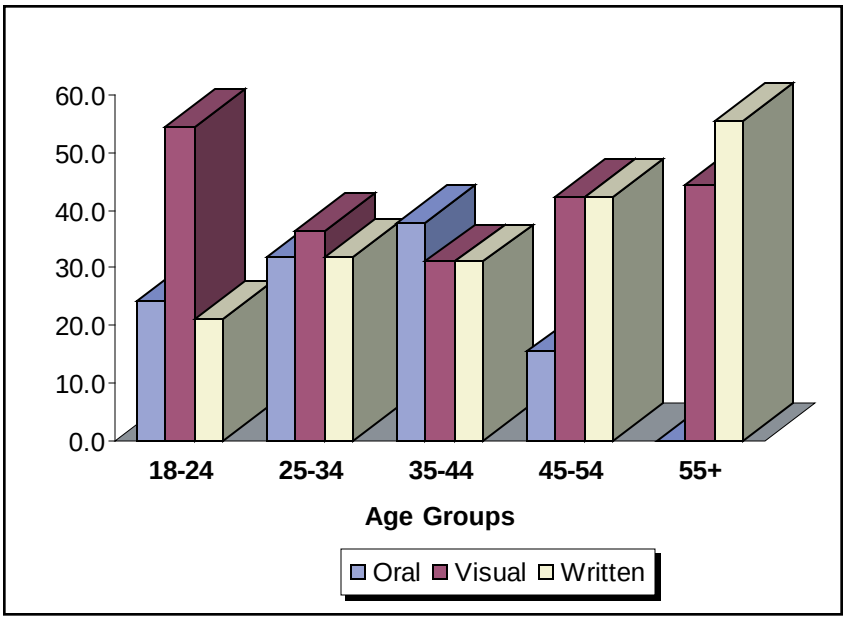


Figure 1-1. Easiest Format to Learn From - Preferences by Age Group
From EPA, 2004, Evaluation of Mercury Risk Communication Messages.

Studies are needed to identify those who should have access to different risk communication tools. For example, web sites would better communicate risks of exposure to methyl-mercury if the intended audience is advanced and familiar with information technology. Printed material, such as fact sheets and brochures, would better communicate risks of exposure to methyl-mercury if the intended audience is more familiar with less technical media tools, such as newspapers, magazines, and library resources.

1.2.2 Mercury Concerns

How do fish become contaminated with mercury?

When mercury goes into a body of water, microorganisms help change its form to methyl-mercury. Methyl-mercury is a highly toxic form of mercury. Small animals and plants take up the mercury as they feed. As larger animals eat those plants and smaller animals, they too take in methyl-mercury. Instead of ridding themselves of the mercury, often plants and animals store the mercury in their body. This process continues, with levels of mercury increasing, up the food chain. This process is known as bioaccumulation. Higher-order carnivorous fish, such as sharks and swordfish, have a higher mercury concentration than lower-order fish. This process can be found in greater detail in Appendix A.

Do some fish contain more mercury than others?

Yes. Freshwater fish caught by recreational or subsistence fishermen (people who fish for their food) from contaminated waters have been shown to have particularly high levels of methyl-mercury. Certain species of commercially available saltwater fish, such as shark and swordfish, kingfish and tilefish also can contain high levels of mercury.

Are the fish caught in fresh water lakes and streams safe to eat?

There can be a risk of contamination from mercury in fresh waters from either natural or industrial causes that would make the fish unsafe to eat. EPA provides some current advice on fish consumption from fresh water lakes and streams, but states have the direct responsibility to provide fish consumption advisories to their citizens.

If you are pregnant or could become pregnant, are nursing a baby, or are feeding a young child, limit consumption of freshwater fish caught by family and friends to one meal per week. For adults, one meal is six ounces of cooked fish or eight ounces of uncooked fish. For a young child, one meal is two ounces of cooked fish or three ounces of uncooked fish.

Many states collect data on mercury levels in fish from local waters. Check with your state or local health department for specific advice on waters where your family and friends are fishing.

What about fish from stores and restaurants?

In addition, EPA and the U.S. Food and Drug Administration (FDA) have issued a joint advisory on mercury in fish bought from stores and restaurants, which includes ocean and coastal fish as well as other types of commercial fish. EPA and FDA advise that women who are pregnant or could become pregnant, nursing mothers and young children not eat shark, swordfish, king mackerel, or tilefish. EPA and FDA also advise that women of childbearing age and pregnant women may eat an average of 12 ounces of fish purchased in stores and restaurants each week. Therefore, if in a given week you eat 12 ounces of cooked fish from a store or restaurant, then do not eat fish caught by your family or friends that week.

Advice on locally caught fish is available in local fish advisories. EPA provides some general guidance on freshwater fish caught from local waters. However, the Agency recommends that women who are or could become pregnant, nursing mothers and young children follow the FDA advice for coastal and ocean fish caught by family and friends. For more information on mercury in these fish, please contact the Food and Drug Administration or visit their web site at www.cfsan.fda.gov/~lrd/tphgfish.html.

What are fish advisories?

Generally, local governments protect people from possible risks of eating contaminated fish by monitoring their waters and issuing fish advisories when contaminant levels are unsafe. While most of the nation's waters contain fish that are safe to eat, consumption advisories may recommend that people limit or avoid eating certain species of fish caught from certain lakes, rivers or coastal waters. In some cases, advisories apply to specific water types, such as lakes, or they may include recommendations for specific groups, like pregnant women or children.

Advisories apply to locally caught fish or wildlife, as well as fish purchased in stores and restaurants. Find out about nationwide advisories by visiting www.epa.gov/waterscience/fish/. Many states have increased the number of notices of "no restriction" or safe eating guidelines to tell the public that the fish from certain areas have been tested and are safe to eat. Statewide advisories are also issued by many states: they warn the public of possible risks from eating certain species from certain types of waters. Commercial fishing bans may also be issued which forbid the harvest and sale of fish, shellfish, and/or wildlife species from a designated waterbody or area.

Where can I get more information about fish advisories?

For more information about the National Listing of the Advisories, you can visit the EPA's web site at www.epa.gov/waterscience/fish/. To find out how to select and prepare fish, read "A Guide to Healthy Eating of the Fish You Catch," found in Appendix M. For more information about reducing your health risks from eating fish you catch, contact the local or state health or environmental protection department. You can find the telephone number in the blue section of your local telephone directory. Or you can find the name and number of a state or local fish advisory contact at the EPA web site.

2.0 Introduction: Communicating Mercury Risk and Its Effects on the Environment and Human Health to the Public

Persistent, bioaccumulative and toxic (PBT) chemicals, such as polychlorinated biphenyls (PCBs), dioxins, and mercury, are a major focus of the U.S. Environmental Protection Agency's (EPA's) primary goal to communicate environmental and health risks to the public. This initiative also has increasingly become a responsibility of Federal, state, and local officials, as well as private groups and organizations. PBT chemicals pose great environmental risk to media such as air and water, and because they bioaccumulate in fish and wildlife, once consumed, result in health risks for many people. The primary method of exposure to many PBT chemicals is through foods, and the most at-risk groups are pregnant women, children, and subsistence fishermen because of their consumption of contaminated fish.

> The primary route of exposure for many PBT chemicals is through foods.

The purpose of this document is to convey recent work performed concerning risks of exposure to methyl-mercury to the risk communicators at various levels. The focus of this document is on PBT mercury, specifically methyl-mercury, and its effects on human health resulting from the consumption of contaminated fish. Exposure to methyl-mercury results in detrimental effects to the central nervous system (CNS). Acute exposure to very high levels of methyl-mercury may lead to blindness, deafness, unconsciousness, and coma. Chronic exposure to methyl-mercury may result in paresthesia (numbness and a tingling sensation around the lips, fingers, and toes), bodily discomfort, blurred vision, speech difficulties, and constriction of the visual field (U.S. EPA 2003a).

EPA's Office of Research and Development (ORD) began a pilot program to enhance the communication of scientific research results to the Agency's stakeholders, such as state, local, and county governments; local health departments; and private citizens. This pilot program is part of a new process called Science Results Integration (SRI). The goal of this program is to provide these stakeholders with information in the most useful and easy-to-understand form. Too often, research projects and results related to mercury risks are published in peer review journals and technical magazines. Most people do not have free and easy access to these publications, and the information presented is difficult for those unfamiliar with scientific and technical terminology.

This document hopes to address three questions related to at-risk groups and their exposure to methyl-mercury through contaminated fish consumption:

- Have all at-risk groups been identified?
- What are effective means of communicating the possible, negative health effects of methyl-mercury exposure and exposure prevention to at-risk groups?
- Are the potential health risks heterogeneous, in that risks vary lake by lake and fish by fish?

This mercury risk communication document provides readers with useful and easy-to-understand information on methyl-mercury, exposure to methyl-mercury through contaminated fish consumption, background information on at-risk groups, and summaries of research initiatives and case studies that examine potential health risks and variances. In this document, readers also will have access to tables and graphs identifying data and trends in mercury research, and outreach materials, such as tear-out fact sheets and brochures, that can be reproduced. EPA ORD hopes that sharing this information with stakeholders and risk communicators will help others establish mercury risk communication programs and improve efforts already in progress to be inclusive of all at-risk groups.

3.0 Mercury and Health Effects

3.1 Background

Mercury is a toxic metal. It is a liquid at room temperature, but volatilizes readily under ambient conditions. It is found in three forms: elemental mercury, inorganic mercury compounds, and organic mercury compounds, such as methyl-mercury. The global mercury cycle occurs in four stages: emission to the atmosphere, transformation and transport in the atmosphere, deposition to the earth, and re-emission to the atmosphere. This process is described in greater detail in Appendix B. Mercury is emitted to the environment from natural sources and anthropogenic, man-made sources. See Figure 3-1.

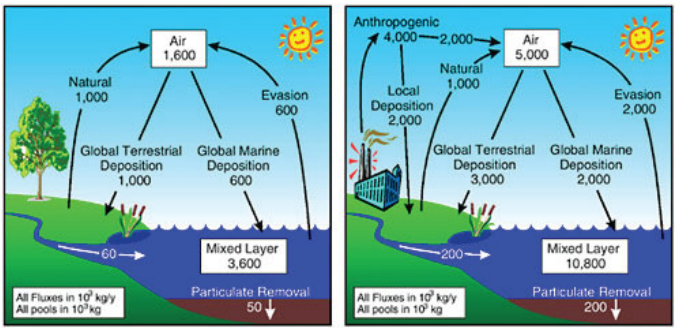


Figure 3-1. Pre-industrial *(left)* and current *(right)* global mercury cycle. Reference: Norling, P., et al. (eds). Water and Sustainable Development: Opportunities for the Chemical Sciences — A Workshop Report to the Chemical Sciences Roundtable.

3.2 Mercury Emissions

Natural mercury emissions occur as the result of the volatilization of mercury in marine and aquatic environments and vegetation, volcanic emissions, and forest fires. Anthropogenic emissions occur as the result of human activities. It is estimated that 40 to 75 percent of current atmospheric mercury concentrations are from anthropogenic sources (U.S. EPA 1997c). Anthropogenic sources of mercury include area sources, combustion sources, and manufacturing sources. Area sources of mercury emissions are small and numerous and tend to be difficult to locate geographically. These include lab use, dental preparations, landfills, mobile sources, and wastewater treatment plants. Approximately 87 percent of anthropogenic emissions of mercury are from combustion sources, which primarily include utility boilers, municipal solid waste incineration, medical waste incineration, sewage sludge incineration, and commercial and industrial boilers. EPA has identified fossil-fuel power plants as the largest source of mercury emissions (NRC 2001). Manufacturing sources include both primary and secondary production processes. Examples of primary sources include chlor-alkali production, lime manufacturing, battery production, electrical apparatus manufacturing, copper and lead smelting, and pulp and paper mills. Secondary production processes are mostly recycling activities, such as fluorescent lamp recycling.

3.2.1 Mercury Control Strategies

Mercury control strategies can be environmental media-focused (i.e. air, land, water), environmental source-focused, or product-focused. Standards and programs also exist to limit occupational exposure to mercury in the workplace or during its transport. Control strategies are undertaken at the Federal, state, and international levels.

Federal Strategies

Environmental media-focused strategies specify a maximum acceptable mercury concentration for different environmental media, based on scientific or risk-based criteria. These include Maximum Contaminant Levels (MCLs) for drinking water and Ambient Water Quality Criteria and Water Quality Guidance for the Great Lakes System for surface water. There are no ambient standards for mercury for air or soil.

Environmental source-related strategies specify, for individual sources or waste types, the conditions associated with mercury use, disposal, and release. For example:

- The import of foods containing residues from mercury-containing pesticides not registered for use in the U.S. is banned.
- Some wastes, such as waste from brine purification muds and wastewater treatment sludge from the mercury cell process of chlor-alkali production, are defined as hazardous due to the presence of mercury.
- Air emissions of mercury from hazardous waste combustion in boilers and industrial furnaces are regulated under the Resource Conservation and Recovery Act (RCRA) and the Clean Air Act (CAA).
- Water releases from industrial facilities are limited under industry-specific standards, based on available control technologies.
- Allowable levels of mercury in wastewater treatment plant sludge are limited under the Clean Water Act (CWA) (U.S. EPA 1997c).

Product-focused strategies specify the conditions under which mercury may be used in the manufacture of products such as batteries, paints, pesticides, and dental products. The use of mercury in batteries has been phased out or limited by the Mercury-Containing and Rechargeable Battery Management Act of 1996. No uses of mercury in paints or pesticides currently exist in the U.S. Dental amalgams containing mercury are regulated as Class II medical devices, which places special controls on their use (U.S. EPA 1997c).

Also, the Clear Skies Initiative, proposed in 2002, establishes a new cap and trade program for mercury. The Initiative proposes to reduce mercury emissions by 70 percent by the year 2018 (U.S. EPA 2002c),

State Strategies

State strategies to reduce mercury emissions tend to be environmental source-focused or product-focused because of the comprehensive media-specific strategies implemented at the Federal level. State environmental source-focused controls include the following:

- Florida and New Jersey limit mercury emissions from municipal solid waste incinerators.
- Wisconsin requires medical waste incinerators with capacities of greater than five tons/day to test for mercury during the first 90 days of operation and again the following year. The Wisconsin Department of Natural Resources also has planned to consider more stringent regulations of mercury emissions from utilities in June 2003. This proposal establishes a cap and trade program requiring a total of 90 percent reductions in mercury emissions over the next 15 years (Wisconsin 2003).
- Michigan requires businesses to report mercury use and water discharge information.
- Minnesota has established management standards for facilities recycling mercury-containing hazardous wastes.

Product-focused strategies and standards are more common at the state level. Many states have regulations restricting or banning the use of mercury in household batteries. States also regulate the use and/or disposal of mercury in white goods, electrical components, dental amalgams, toys, lighting, packaging, pharmaceuticals, and fireworks (U.S. EPA 1997c).

The Health Care Without Harm web site www.hcwh.org/mercury/ordinances lists the various laws and regulations that states and localities have enacted regarding mercury in the community. Michigan, Connecticut, Massachusetts, Maine, Oregon and Maryland have banned the sale of mercury fever thermometers. Indiana, California, and New Hampshire all have placed restrictions on the sale of these types of mercury thermometers. Cities such as Boston, Massachusetts; Chicago, Illinois; San Francisco, California; Ann Arbor, Michigan; and Duluth, Minnesota, have banned mercury fever thermometers as well.

Other localities have taken a different approach to removing the threat of mercury in their respective regions. Mountain View, California, conducted a "Money for Mercury" program, which offered residents a discount for a non-mercury thermometer when turning in a mercury-based thermometer. Broward County, Florida, recently offered a thermometer exchange, in which non-mercury thermometers were traded for mercury thermometers. The EPA Safe Mercury Management web site www.epa.gov/epaoswer/hazwaste/mercury/index.htm provides links to these local initiatives and programs.

International Strategies

International strategies to reduce mercury emissions include the Great Lakes Binational Toxics Strategy and the North American Regional Action Plan (NARAP). Canada and the U.S. signed the Great Lakes Binational Toxics Strategy in 1997. It was developed to help achieve the goals of the Great Lakes Water Quality Act. Mercury is considered to be an immediate priority of the program. Both countries are working to reduce and eventually to eliminate emissions of mercury and mercury compounds in the Great Lakes Watershed. The NARAP is an agreement between Canada, Mexico, and the U.S. that addresses concerns associated with the sound management of chemicals. One of the regional action plans focuses on reducing mercury levels released to and existing in an environmental area, in an attempt to prevent or reduce exposure to sensitive ecosystems, fish, wildlife, and humans (U.S. EPA 1997c).

3.2.2 Mercury Control Technologies

Pollution Prevention Measures

Pollution prevention measures, frequently referred to as source reduction, include use reduction, raw material substitution, process or equipment modification, product redesign, training, improved inventory control, production planning and sequencing, and better management practices.

Examples of toxics use reduction can be found in battery and fluorescent lamp manufacturing. Historically, mercury was used in household batteries to inhibit side reactions and reduce corrosion of the battery casings. It was also used as a component of the zinc amalgam in alkaline batteries. Over the last few years, the battery industry has eliminated the use of mercury in inhibiting side reactions and battery casing corrosion. It has also reduced the amount of mercury used in zinc amalgams to trace amounts. The fluorescent lamp manufacturing industry also drastically reduced the amount of mercury used per lamp (U.S. EPA 1997c).

The battery industry has also been involved in raw materials substitution. Mercury is used in mercuric oxide batteries. These tend to be small batteries with a constant current supply. The industry has developed alternatives to mercuric oxide batteries, such as zinc-air and silver-oxide batteries, which can replace mercuric oxide batteries. Another example of material substitution is the replacement of mercury amalgam dental fillings with gold, ceramic, porcelain, polymers, composites, and glass ionomers.

Process modification is occurring in some chlor-alkali manufacturing plants. In mercury cell chlor-alkali plants, mercury is used as a flowing cathode in the electrolytic cells. There are many opportunities for mercury emissions during this process.

An alternative to the mercury cell process is the membrane cell process, in which no mercury is used, resulting in a reduction in mercury emissions for the industry. Additionally, the membrane cell process is a more energy-efficient process than the mercury cell process (U.S. EPA 1997c).

An example of a better management practice is the use of materials separation. Emissions of mercury from waste incinerators are reduced by removing materials with high mercury concentrations, such as batteries and fluorescent lamps, from the waste stream. This is more effective than reliance on air pollution control devices, which are only partially effective at removing mercury.

Coal Cleaning

Coal cleaning involves physically stratifying the coal and removing impurities, such as high-sulfur or high-ash minerals. Coal cleaning is done to remove ash, moisture, and sulfur from coal to reduce transportation costs, improve power plant efficiency, and upgrade the value of the coal (U.S. EPA 1995). Approximately 77 percent of eastern and midwestern bituminous coal is cleaned. Coal cleaning has an average mercury removal efficiency of 21 percent. Advanced methods of coal cleaning, such as column froth flotation or selective agglomeration, can remove more mercury. These methods, used after conventional cleaning, have an average mercury removal efficiency of 51 to 68 percent (U.S. EPA 1997c).

Flue Gas Treatment

Flue gas treatment involves the use of air pollution control devices to reduce mercury emissions. Different treatment technologies are used for commercial/industrial and utility boilers. Flue gas treatment includes use of one or more of the following technologies: carbon filter beds, wet scrubbers, depleted brine scrubbing, treated activated carbon adsorption, selenium filters, activated carbon injection, flue gas desulfurization (FGD) scrubbers, and spray dryer FGD systems.

Carbon filter beds incorporate a series of filters. Flue gas flows through the filters in one direction, while carbon flows through in a different direction. The estimated removal efficiency is approximately 99 percent. Carbon filter beds are currently used for municipal solid waste incinerators, utility boilers, and industrial boilers. Potential drawbacks for the system include the potential for "hot spots" within the bed, which can lead to bed fires, and the need to dispose of the mercury-containing bed material. There is also the possibility of releases of mercury during the charring of the coal to create the carbon.

Wet scrubbers can involve a one-, two-, or three-stage process. The removal efficiency can be greater than 90 percent for water-soluble mercury species, but is lower for elemental mercury. Wet scrubbers are currently used on medical waste incinerators and approximately 25 percent of coal-fired boilers in the U.S. and on municipal waste incinerators in Europe. A potential drawback of this technology is the required treatment of the wastewater prior to disposal.

Depleted brine scrubbing is used to control emissions at mercury cell chlor-alkali plants. It uses the discharged brine from the chlorine cell as a scrubbing liquor to further reduce mercury emissions. The removal efficiency for mercury is approximately 98 percent.

Treated activated carbon adsorption uses a packed bed of sulfur- or iodine-impregnated carbon to reduce emissions of both elemental and oxidized mercury. It is used in various industries, including chloride-alkali plants, and has a removal efficiency of approximately 90 percent.

Selenium filters operate on the theory that there is an affinity between mercury and metallic selenium. They are used at copper and lead smelters and have limited use at municipal waste incinerators, crematories, and utilities in Europe. The mercury removal efficiency is approximately 90 percent and is affected by the mercury concentration and forms in the flue gas, flue gas temperature, and flue gas dust content. Potential drawbacks of this technology include the possible emissions of selenium from the filter and the need to dispose the selenium- and mercury-containing filters after use.

Activated carbon injection involves the injection of activated carbon into flue gas upstream of another air pollution control device to collect the particles. It is used at municipal waste incinerators and medical waste incinerators and has been used at pilot-scale utility plants. Mercury removal efficiencies are highly variable (50 to greater than 95 percent). The removal efficiency is dependent on flue gas volume, temperature, vapor and particulate phase constituents, mercury concentration and species, the additional air pollution control device used, and the type and amount of activated carbon used. A potential drawback of this technology is the need for disposal of the increased amount of particulate matter (PM) resulting from utility boilers.

FGD systems are used at utility boilers to reduce the emissions of sulfur oxides (SOx), but can also reduce mercury emissions. FGD scrubbers are currently installed on approximately 25 percent of coal-fired utility boilers in the U.S. Mercury removal efficiencies vary widely. Spray dryer FGD systems are used at approximately 1 percent of coal-fired boilers. Average mercury removal efficiencies for spray dryers range from 60 to 70 percent (U.S. EPA 1997c).

Incentive-based Systems

Incentive-based systems provide regulated industries with more flexibility than traditional regulatory programs. These programs traditionally set a limit on, or cap, the allowable level of emissions and allow flexibility on how the limits are met. Many incentive-based systems allow for transfer or banking of allowable emissions. This can create incentives for innovation, which can lead to increased and faster reductions.

Co-control

Co-control is the control of mercury by control devices or other measures designed or prescribed to limit emissions of pollutants other than mercury. Fuel switching, such as switching from high-sulfur to low-sulfur coal or from coal to natural gas to achieve emissions reductions for SOx, may also lead to decreased mercury emissions. EPA has also determined that implementing the national SOx strategy to meet National Ambient Air Quality Standards (NAAQS) for PM would lead to a reduction in mercury emissions from utility boilers of 11 tons per year (U.S. EPA 1997c).

3.2.3 Emissions Trends and Reductions

Increased energy conservation or the use of renewable energy sources will also lead to a reduction in mercury emissions. The overall consumption of mercury for use in industrial or manufacturing products or processes is decreasing. Industrial consumption of mercury dropped almost 75 percent between 1988 and 1996. This was due mostly to the elimination of mercury in paint (20 percent) and the reduction of mercury in batteries (36 percent) (U.S. EPA 1997c). Mercury use also decreased approximately 50 percent between 1995 and 2000, due mostly to the decreased use of mercury by the chlor-alkali industry (U.S. EPA & Environment Canada 2002). At the same time, secondary production of mercury has increased and is expected to continue to increase. This is due to increased recycling of mercury-containing electrical equipment, such as fluorescent lamps and thermostats (U.S. EPA 1997c). The U.S. EPA has set a goal of a further 50 percent reduction in mercury use by 2006 (U.S. EPA & Environment Canada 2002).

Recent studies have shown that total mercury emissions are on the decline. Between 1990 and 1997, mercury emissions from municipal solid waste incinerators and medical waste incinerators dropped 50 and 75 percent, respectively (U.S. EPA 1997c). Total mercury emissions declined approximately 25 percent during the same period. While official inventories are not available, estimated mercury emissions have decreased more than 40 percent between 1990 and 2001 (U.S. EPA & Environment Canada 2002). These reductions are expected to continue due to the closure of many medical waste incinerators, changes in the waste stream due to materials separations and incinerator regulations, and the switch from mercury cells to membrane cells at many chlor-alkali plants (U.S. EPA undated). The U.S. EPA has also set a goal of a 50 percent reduction in mercury emissions by 2006 (U.S. EPA & Environment Canada 2002).

3.3 Human Exposure to Mercury

3.3.1 Health Effects

Human health effects from mercury exposure are dependent on the form of mercury, type of exposure, and degree of exposure. Exposure to elemental mercury and methyl-mercury can lead to adverse impacts on the central nervous system (CNS). Due to the severe effects of exposure, EPA has established a reference dose (RfD) for methyl-mercury of 0.0001 mg/kg-day (U.S. EPA 2003a). The RfD is an estimate of a daily exposure of the human population (including sensitive subgroups) to a non-carcinogen at which level adverse effects are unlikely to occur. EPA used a benchmark dose (BMD) analysis described in Appendix C to quantify the dose-effect relationship resulting in the RfD for methyl-mercury.

Table 3-1. Health Effects Resulting from Exposure to Mercury and Methyl-mercury

	Elemental Mercury	Inorganic Mercury*	Methyl-mercury
Acute Exposure	tremors, mood changes, slowed sensory and motor nerve function	nausea, vomiting, and severe abdominal pain	blindness, deafness, unconsciousness, and coma**
Chronic Exposure	tremors, irritability, excessive shyness, and erethism, or increased excitability	kidney damage	paresthesia (numbness and a tingling sensation around the lips, fingers, and toes), bodily discomfort, blurred vision, speech difficulties, and constriction of the visual field

Reference: U.S. EPA 2003a.
*Exposure to inorganic mercury usually occurs through oral ingestion.
**Health effects resulting from acute exposure to very high levels of methyl-mercury.

Recent studies have also linked exposure to mercury to an increased risk of heart disease and cardiovascular death. A study on the effects of the consumption of mercury-contaminated fish was conducted as part of the Kuopio Ischaemic Heart Disease (KIHD) Risk Factor Study. Hair, blood, and urine samples were taken from 1,833 Finnish men between 1984 and 1989. The mercury content was determined to be correlated to estimated fish intake. The study found that men with hair mercury concentrations of greater than 2 parts per million (ppm) had a two-fold greater risk of acute myocardial infarction (Salonen et al. 1995). A recent study conducted through Johns Hopkins University also found a correlation between mercury exposure and heart disease. The study compared concentrations of mercury in toenail clippings of men from eight European countries and Israel and occurrences of a first myocardial infarction. The study found that toenail mercury concentration was directly correlated to the risk of myocardial infarction. The study authors theorized that mercury may predispose people to atherosclerotic disease by promoting the production of free radicals or by inactivating several antioxidant mechanisms (Guallar et al. 2002).

3.3.2 At-risk Groups

There are two aspects of at-risk groups: exposure and sensitivity (U.S. EPA, MDH & SRI 2001). Two groups in the U.S. are at risk due to sensitivity to mercury: women (specifically those who are pregnant, nursing, or of childbearing age) and children. Subsistence fishers, including Native Americans and Alaskan-Native Villagers, are at risk due to their increased exposure

to mercury. Consumption of contaminated fish is the primary source of exposure to mercury in the U.S. (NRC 2001).

Pregnant Women and Women of Childbearing Age

The population at highest risk from mercury exposure is children of women who consumed large amounts of fish and seafood during pregnancy (Schoeny 2001). The National Health and Nutrition Examination Survey (NHANES) in 1999 found that mercury levels in women of childbearing age are generally below those considered hazardous. However, approximately 8 percent of women had potentially dangerous amounts of mercury in their blood and hair (CDC 2001a). Based on current birth rates in the U.S., this equates to approximately 60,000 children born each year at risk from mercury exposure (NRC 2001). Fetal exposure to high levels of methyl-mercury may cause loss of muscle coordination, mental retardation, blindness, deafness, and cerebral palsy. Fetal exposure to low levels of methyl-mercury may cause developmental delays and abnormal reflexes (U.S. EPA 2003a). Nursing women who consume large amounts of fish and seafood also place their infants at risk.

Children

Oral ingestion of methyl-mercury may lead to developmental delays in children. Children exposed to elemental mercury or inorganic mercury may suffer from acrodynia. Symptoms of acrodynia include severe leg cramps, irritability, paresthesia, painful pink fingers, and peeling hands, feet, and nose. The occurrence of acrodynia is very rare (U.S. EPA 2003a). The 1999 NHANES study also found that mercury levels in young children were generally below those considered hazardous (CDC 2001a). Most of the health effects found in children are due to in utero exposure.

Subsistence Fishers

The daily average per capita fish consumption in the United States is 4.52 grams per person per day (U.S. EPA 2002a). However, some groups consume much higher amounts of fish, placing them at a much greater risk for mercury exposure. Some tribal consumers may consume as much as 1,000 grams per person per day (Harris 2001). Subsistence fishers also have higher rates of fish consumption due to eating self-caught fish that are contaminated with mercury and other PBT substances. Fish have great cultural significance for many groups in the U.S. For example, the Confederated Tribes of the Umatilla Indian Reservation consider fish to be the first people in creation. Fish are a very important part of tribal traditions, including religion, tribal ceremonies, and social education (Harris 2001). Fishing is part of the "community landscape" (U.S. EPA, MDH & SRI 2001). Fish is also an important part of the diet for many Southeastern Asian communities in the U.S. (U.S. EPA, MDH & SRI 2001).

3.3.3 Fish Consumption Limits and Fish Consumption Advisories

Risk-based fish consumption limits are recommendations on the maximum numbers of meals of a certain type of fish that can be eaten over a specified time period by defined groups of consumers, based on the mercury concentration in the fish tissue (Schoeny 2001). Consumption limits assume the same body weight and meal size for all adult consumers. The FDA currently recommends that children and pregnant and nursing women should avoid eating king mackerel, shark, swordfish, and tilefish. Consumption of fresh or frozen tuna should be limited to three times per month, and consumption of canned tuna, as well as a variety of other kinds of cooked fish, should be limited to 12 ounces per week. A typical serving size of fish is from 3 to 6 ounces (FDA 2001a).

The FDA previously used a 1-ppm level for concentrations of methyl-mercury in fish as its actionable level for fish advisories and removal of commercial fish from marketplaces. The FDA is considering a more stringent consumption limit of 0.0001 mg/kg-day, equivalent to the EPA RfD for consumption of methyl-mercury (FDA 2003).

In addition, states may also issue advisories based on mercury concentrations found in local fish. These can include no-consumption advisories for the general public or sensitive subpopulations, restricted consumption advisories for the general public or sensitive subpopulations, and commercial fishing bans. In 2001, 1,933 fish advisories were issued for mercury, covering 10,179,247 lake acres and 414,973 river miles (U.S. EPA 2002b).

3.4 Other Mercury Risks

Human exposure to mercury can also occur from dental (amalgam) fillings, accidental mercury spills, improper disposal, occupational exposure, drinking water, and ritualistic uses of elemental mercury. The risk of exposure to mercury from these sources, however, is significantly lower than exposure from fish consumption.

3.4.1 Dental Amalgam Fillings

Dental amalgam fillings are composed of approximately 50 percent elemental mercury and an alloy of tin, copper, silver, and zinc. Mercury vapor may be released from amalgam fillings as a result of pressure from chewing or grinding at the rate of 1-3 µg/day (ADA 2003). There is considerable debate over whether this is a significant enough rate of release to create risk of adverse effects. The Centers for Disease Control and Prevention (CDC) recommended and began a research program that was developed and implemented to study the health effects from mercury in amalgam fillings (CDC 2001b, Factor-Livtak, et al. 2003). Significant correlation between amalgam fillings and adverse health effects have not been established (Factor-Livtak, et al. 2003).

3.4.2 Accidental Spills

Exposure to mercury can also occur as the result of accidental spills. Exposure can occur as a result of chemical fires or explosions, uncontrolled hazardous substance releases from accidental spills or abandoned industrial facilities, or contamination of the water supply. While there is no estimate of the likelihood of exposure due to accidental spills, EPA does take measures to minimize the risks. At a spill site, EPA may seal off the con-

taminated area, block vapor releases from ventilation systems, and cover floor drains. EPA will also limit public access to the site (U.S. EPA 1997a).

3.4.3 Improper Disposal

Many mercury-containing products are improperly disposed. These items include fluorescent and mercury-vapor lamps, mercury switches, thermostat probes, thermometers, and dental amalgam. If these items are disposed in a landfill, mercury may be released into the landfill and may ultimately reach groundwater as a result of leachate generation. Incineration of mercury-containing wastes may release mercury emissions into the atmosphere. Mercury spilled from these products may also enter surface water through releases from wastewater treatment plants if these spills are not properly contained (U.S. EPA 1997b).

3.4.4 Occupational Exposures

Occupational exposure is another potential source of human exposure to mercury. The primary source of occupational exposure to mercury is through inhalation of mercury vapor. To protect against occupational exposure to harmful levels of mercury, a number of occupational health organizations have set limits on the safe exposure to mercury in the workplace:

- The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit of 0.1 mg/cubic meter of air (ceiling limit).
- The National Institute for Occupational Safety and Health (NIOSH) has established a recommended exposure limit of 0.05 mg/cubic meter of air (time-weighted average).
- The American Conference of Governmental Industrial Hygienists has assigned a threshold limit value of 0.025 mg/cubic meter of air (time-weighted average) (OSHA 1999).

Occupational exposure to mercury occurs primarily in mercury processing, mercury cell chlor-alkali production, dental use, laboratory use, and through recycling of mercury-containing materials. In studies of chlor-alkali plant workers, urine mercury levels were detected at levels between 12 and 13 times higher in the workers than in the control group. A study of dental workers measured mercury levels in the pituitary glands at autopsy. Mercury levels between 135 and 4,040 µg/kg (median: 815 µg/kg) were detected in the dental workers compared to a median concentration of 23 µg/kg for the general population (ATSDR 1999).

3.4.5 Contaminated Drinking Water

Human exposure to mercury can also occur through contamination of the drinking water supply. The Safe Drinking Water Act requires EPA to determine safe levels of chemicals which do or may cause health effects. National Primary Drinking Water Standards are legally enforceable standards that apply to public water systems. The current standard for mercury is 0.002 mg/L of drinking water (U.S. EPA 2002b). However, approximately 42 million people obtain drinking water from private wells, streams or cisterns. These water sources are not regulated by the EPA (USGS 1998).

3.4.6 Ritualistic Uses of Elemental Mercury

In January 1999, the EPA Office of Emergency and Remedial Response (OERR) created a Task Force on Ritualistic Uses of Mercury. The Task Force was charged to research certain spiritual practices and folk traditions requiring the use of elemental mercury and to recommend an approach to eliminate or reduce exposures to elemental mercury from these activities. Elemental mercury is supplied in religious stores, known as botanicas, and used for medicinal, herbal, or religious practices in some Latino and Afro-Caribbean traditions. Some practices include Santeria, Palo, Voodoo, and Espiritismo. Elemental mercury is used by individuals of these cultures to bring love, luck, or money; to protect against evil; or to speed the action of spells (U.S. EPA 2002d).

Unfortunately, the adverse effects of using elemental mercury in these practices have not been communicated to these cultures. To remedy this problem, Federal, state, and local agencies have participated in formal and informal information gatherings, meetings with community groups, production and distribution of health alerts and outreach materials, investigation of complaints, research funding, risk assessments, voluntary product recalls, measurements of mercury air levels in botanicas and other living areas, and enforcement of applicable regulations. Some outreach materials have included fact sheets, sample labels, web sites, brochures, radio announcements, and press releases. In general, the Task Force hopes to reduce mercury exposure through communication and providing recommendations of realistic and cost-effective actions that will promote health and well-being, while respecting cultural traditions and community autonomy. Specifically, the Task Force recommends that EPA OERR:

- Develop a brochure on mercury describing its hazards and what to do if mercury is spilled. This brochure should serve as a template to be used by local and community groups and be distributed primarily via the web.
- Produce a written statement for distribution to community groups on the DOs and DON'Ts of mercury use. The written statement should include messages from the EPA OERR brochure and stress the needed guidance from community leaders.
- Encourage funding to assist community-based organizations and local health departments to get involved in outreach efforts.
- Work with other EPA media offices to incorporate these ritualistic aspects and traditional uses of mercury in existing education programs (U.S. EPA 2002d).

4.0 Mercury Risk Communication Program Activities

This chapter summarizes several EPA projects that demonstrate mercury risk communication program activities available for public utility. It also describes mercury risk communication efforts initiated by organizations and Federal agencies such as the U.S. Geological Survey (USGS), CDC, FDA, and the United Nations. Program contact information also has been included for further references of information.

4.1 EPA Mercury Risk Communication Efforts to Protect Human Health

4.1.1 Fish Quality Index

Many people are exposed to PBT chemicals, such as methyl-mercury, PCBs, or dioxins, through food consumption and are at high risk for methyl-mercury toxicity because they consume contaminated fish, particularly subsistence fishermen, pregnant women and children. Unfortunately, exposure to PBT chemicals has been hard to capture because they amplify in the food chain, even though ambient levels of these PBT substances in lakes and streams are within acceptable limits.

As a result, many at-risk groups have not been targeted for communication of the human health risks resulting from exposure to PBT chemicals through food consumption, and a means of effectively communicating these risks does not readily exist. To address these concerns, EPA's ORD has worked through its National Risk Management Research Laboratory (NRMRL) to define regions and specific lakes and streams that have high levels of native fish consumption and to identify where high mercury or other PBT concentrations in water typically occur. This effort also compiles mercury or other PBT concentrations from waterbodies and fish that inhabit these lakes and rivers from historical data or from data that have been recently collected. NRMRL also is working to complete the final product of this effort, a user-friendly risk communication tool, the Fish Quality Index.

Subsistence fishermen are exposed to contaminated fish when gathering fish from lakes and streams within tribal lands. Tribal members who consume these fish are then at risk, as well. Consumption levels among the members following a subsistence diet vary depending on the location of the persons living in a subsistent community, typically Native Americans and persons living in Alaska Native Villages. However, a subsistence diet typically includes fish consumption on the average of four times weekly.

The Fish Quality Index is a color-coded pictogram for various fish species that will educate users on levels of fish contamination. For example, fish color-coded green are safe to eat, even at subsistence consumption levels. Yellow-coded fish are safe to consume once a month, while red-coded fish may be safe only if eaten less than once a year. This easy-to-understand map-based tool will educate the public, and especially the sensitive populations, as to the relative safety of lakes, streams, and safer species of fish.

The Fish Quality Index has been completed nationwide and is currently in its final testing stage.

Program contact: Dan Petersen, EPA, ORD, NRMRL, 26 West Martin Luther King Drive (G75), Cincinnati, OH 45268, 513-569-7831, petersen.dan@epa.gov, or www.epa.gov/ORD/NRMRL.

4.1.2 National Listing of Fish and Wildlife Advisories

The National Listing of Fish and Wildlife Advisories (NLFWA) contains information on contaminated fish that may not be safe to eat, listed by state and local area. The consumption advisories listed in the NLFWA are initiated by state, local, and tribal governments, as well as U.S. territories. EPA's Office of Water publishes the NLFWA, and the most recent listing of 2001 NLFWA advisories was published in May 2002. The NLFWA web site, www.epa.gov/waterscience/fish/, also includes the names and telephone numbers of state or local agencies that list the most current fish and wildlife advisories.

NLFWA is designed to help the public find areas where fish are low in chemical pollutants, and members of state, local, and tribal communities can use the NLFWA to get information on these consumption advisories. NLFWA also can be used to generate national, regional, state or local maps that illustrate advisory information. In general, the consumption advisories found in NLFWA recommend that people limit or avoid eating certain species of fish caught from certain lakes, rivers or coastal waters. In some cases, advisories apply to specific water types, such as lakes, or they may include recommendations for specific groups, such as pregnant women, children, or the elderly. Advisories apply to local fish or wildlife, as well as fish purchased in stores and restaurants.

Most advisories focus on five primary chemical contaminants, specifically mercury, PCBs, chlordane, dioxins, and dichloro-

diphenyl trichloroethane (DDT). These chemical contaminants persist for long periods in sediments, and when bottom-dwelling animals digest and accumulate them, exposure to fish with these five primary contaminants will occur. Levels of these contaminants will increase as they move up the food chain, so top predators in a food chain, if exposed, such as largemouth bass or walleye, may have contaminant levels several times higher than that of the water.

Some states have issued notices of "No Restriction" to inform the public that the fish from certain areas have been tested and are safe to eat. Statewide advisories are also issued by many states that warn the public of possible risks of eating certain species from certain types of waters. Commercial fishing bans may also be issued which forbid the harvest and sale of fish, shellfish, and/or wildlife species from a designated waterbody or area.

The 2001 NLFWA, which can be found at www.epa.gov/waterscience/fish/, lists 2,618 advisories in U.S. states and territories and contains the following information for each advisory:

- Species and size of fish or wildlife under advisory
- Chemical contaminants covered by the advisory
- Location and surface area of the waterbody under advisory
- Population subject to the advisory
- Local contacts (including names, phone numbers and web sites).

States typically issue five major types of advisories and bans to protect both the general population and specific subpopulations[1]:

No-consumption advisory for the general population — Issued when levels of chemical contamination in fish or wildlife pose a health risk to the general public. The general population is advised to avoid eating certain types of locally caught fish or wildlife.

No-consumption advisory for sensitive subpopulations — Issued when contaminant levels in fish or wildlife pose a health risk to sensitive subpopulations (such as children and pregnant women). Sensitive subpopulations are advised to avoid eating certain types of locally caught fish or wildlife.

Restricted consumption advisory for the general population — Issued when contaminant levels in fish or wildlife may pose a health risk if too much fish or wildlife is consumed. The general population is advised to limit eating certain types of locally caught fish or wildlife.

Restricted consumption advisory for sensitive subpopulations — Issued when contaminant levels in fish or wildlife may pose a health risk if too much fish or wildlife is consumed. Sensitive subpopulations are advised to limit consumption of certain types of locally caught fish or wildlife.

Commercial fishing ban — Issued when high levels of contamination are found in fish caught for commercial purposes. These bans prohibit the commercial harvest and sale of fish, shellfish, and/or wildlife species from a designated waterbody. In addition to the five major types of advisories, states are increasingly issuing notices of no restriction or statewide advisories.

A **No Restriction advisory** is issued to inform the public that fish from specific waterbodies have been tested for chemical contaminants, and the results have shown that specific species of fish from these waters contain very low levels and are thus safe to eat without consumption restrictions. In contrast, a **Statewide advisory** is issued to warn the public of the potential human health risks from widespread chemical contamination of certain fish species or of species from certain types of waterbodies (e.g., lakes, rivers, and/or coastal waters) within the state.

Twenty-eight states currently have statewide advisories for contaminants in waters or certain waterbody types for one or more species of fish. Please see Appendix D for a summary of the statewide advisories.

Program contact: Jeff Bigler, EPA, Office of Science and Technology, National Fish and Wildlife Contamination Program (4305T), 1200 Pennsylvania Avenue, NW, Washington, DC 20460, 202-566-0400, bigler.jeff@epa.gov, or www.epa.gov/waterscience/fish/.

4.1.3 National Study of Chemical Residues in Lake Fish Tissue

Monitoring fish in lakes and reservoirs for chemical contamination is critical in order to protect human health because these areas are important for sport fishing, subsistence living, and other recreational activities. The 2001 update to EPA's NLFWA reports that 79,119 lakes (11,277,276 lake acres) and 485,205 river miles in the U.S. were under fish advisory in 2001 (U.S. EPA 2002b). Therefore, EPA is conducting a screening-level study to estimate the national distribution of selected PBT residues in fish tissue from lakes and reservoirs in the U.S. The National Study of Chemical Residues in Lake Fish Tissue (or National Fish Tissue Study) is a screening-level study and is led by EPA's Office of Water, with help from EPA's ORD and Office of Prevention, Pesticides, and Toxic Substances; EPA Regions; state and tribal agencies; the National Park Service; and the Tennessee Valley Authority. The goal of the National Fish Tissue Study is to define national background levels for 265 chemicals in fish, establish a baseline to track progress of pollution control activities, and identify areas where contaminant levels are high enough to warrant further investigation. Lakes are the primary focus of this study because they serve as permanent, stable environments for contamination accumulation. Also, the accumulation of PBT substances and other contaminants is easier to detect in lakes than in reservoirs.

[1] The language used here to explain the five major types of advisories and bans can be found in the U.S. EPA Office of Water, *Fact Sheet — Update: National Listing of Fish and Wildlife Advisories*, EPA-823-F-02-007, May 2002 (U.S. EPA 2002b).

Contaminants in lakes and other waterbodies are the result of direct discharges of chemicals into the water, chemical air deposition, and agricultural or urban runoff of toxics.

EPA initiated the National Fish Tissue Study in 1998 as a priority activity under the Agency's PBT Initiative. The National Fish Tissue Study is the first national fish tissue survey to be based on a random sampling design that allows EPA to develop national estimates of mean PBT concentrations in fish tissue. The study also provides data on the largest set of PBT chemicals evaluated in fish. The study consists of four phases:

- Planning (1998-1999), including study design development, random lake selection, and target chemical selection.
- Mobilization (1999-2000), including orientation workshops, development of partnerships, production of quality assurance, plans and sampling plans, lake reconnaissance, and pilot sampling events at 26 lakes.
- Implementation (2000-2003), including sampling of 261 lakes in 44 states in 2000-2001; chemical analysis of 288 first-year fish samples in 2001; database development; sampling of about 125 lakes per year in 2002-2003; and chemical analysis of about 250 fish samples per year in 2001, 2002, and 2003 samples.
- Data Analysis and Reporting (2004-2005), including statistical analysis of fish tissue, residue results, preparation and distribution of a final study report, and data archive into EPA's new STORage and RETrievel repository (STORET).

EPA has worked with partner agencies to collect fish from 500 randomly selected lakes and reservoirs in the U.S. See Figure 4-1. The lakes (defined as permanent bodies of water with depths of at least 1 meter) were divided into six size categories, ranging from 2.5 to over 900,000 surface acres. Composites for sampling consisted of five adult fish of similar size that were large enough to provide 560 grams of tissue for analysis of fillets for predators and whole bodies for bottom dwellers. EPA analyzed each composite for 265 chemicals, including mercury. EPA also analyzed the fish tissue for arsenic, 17 dioxins and furans, 159 PCB congeners, 43 pesticides, and 40 other organics, including phenols.

Based on first-year results taken from fish samples collected in 1999-2000, mercury was detected in 139 sites (or lakes) in the U.S. The minimum concentration of mercury detected was 23.2 ppb, and the maximum concentration of mercury detected was 1,377 ppb.

Program contact: Leanne Stahl, EPA, Office of Water, Office of Science and Technology (MC4305T), 1200 Pennsylvania Avenue, N.W., Washington, DC 20460, 202-566-0404, stahl.leanne@epa.gov, or www.epa.gov/waterscience/fishstudy/.

EPA's Office of Water also published two informative brochures on health risks due to the consumption of contaminated fish. The April 2001 brochure, "Should I Eat the Fish I Catch? A Guide to Healthy Eating for Women and Children," is a two-page document that provides the general public with EPA recommendations on fish consumption and FDA advice on eating fish purchased in stores and restaurants. The 2001 brochure was developed in collaboration with the Agency for Toxic Substances and Disease Registry (ATSDR).

The April 2002 brochure, "A Guide to Healthy Eating of Fish You Catch," provides EPA recommendations for catching, cleaning, and cooking sporting fish from the nation's lakes, rivers, oceans, and estuaries. The 2002 brochure also was developed in collaboration with ATSDR. Both brochures are included in Appendix M and may be reproduced without EPA permission.

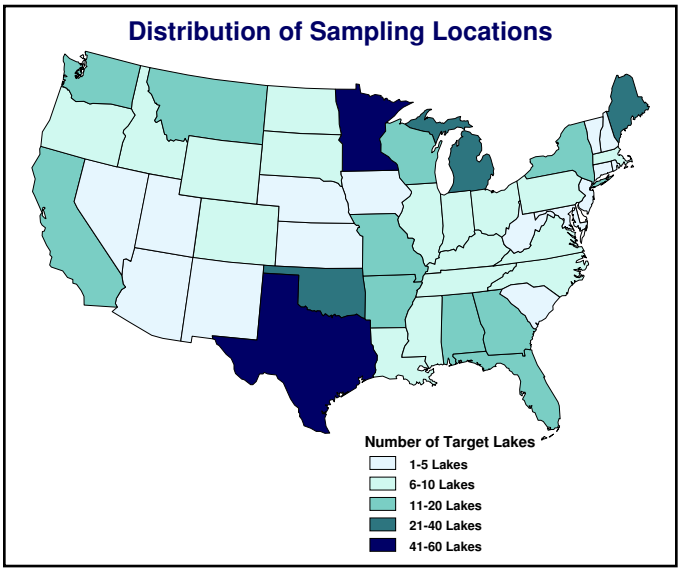


Figure 4-1. Map of the U.S. Displaying the Distribution of Sampling Locations for All Fish Composites.

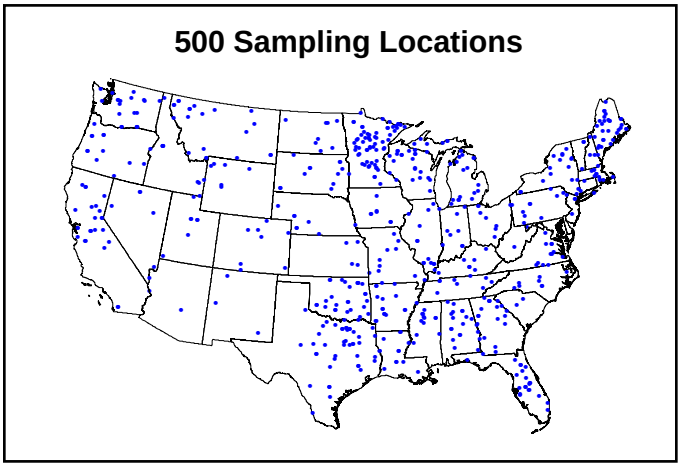


Figure 4-2. Map of the U.S. Displaying the 500 Sampling Locations for All Fish Composites.

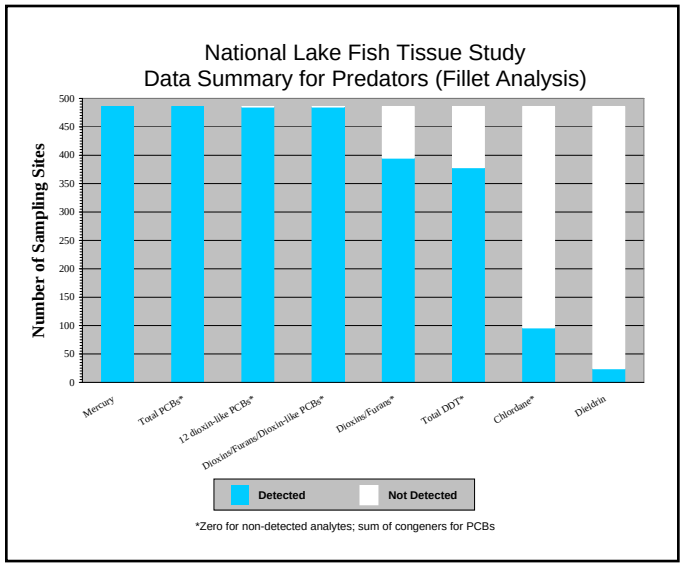


Figure 4-3. Chart of PBT Chemicals Detected at Sampling Sites.

4.1.4 Mercury Measurements and Analysis

The Environmental Sciences Division (ESD) of the EPA ORD National Exposure Research Laboratory (NERL) has developed several approaches to measure and analyze mercury levels. A recently developed approach uses a commercially available instrument to directly analyze liquid or solid mercury samples without digestion. The analysis method is much faster than conventional methods of measuring mercury, requires smaller samples, and produces virtually no laboratory waste. It has been validated for both whole-fish and fish muscle tissue.

The fact that this approach utilizes smaller samples enables researchers to use milligram-size concentration samples to represent the entire fish muscle, making possible non-lethal mercury sampling, as well as measurements on samples intended for other analyses.

This method was tested on fish collected from Lake Mead by researchers from ESD, and as expected, mercury concentrations were higher in fish of higher trophic level and larger size. Mercury concentrations were found to be highly correlated among muscle, liver, and blood tissues, with evidence of redistribution toward the liver at high concentrations. Use of this approach to analyze fish tissue resulted in reasonably accurate data.

A similar effort, led by NERL, is being used to study the Aleut community on St. Paul Island in the Arctic. In an outreach effort with the Big Valley Rancheria (the Big Valley Band of Pomo Indians), a similar type of mercury analyzer may be acquired by a tribe to assess mercury exposures in areas of California and used to detect levels of mercury in hair, fish tissue, and feathers.

Program contact: Robin Baily, EPA, ORD, D343-01, Research Triangle Park, NC 27711, 919-541-7906, baily.robin@epa.gov, or www.epa.gov/ebtpages/pollsoilcmercury.html.

4.1.5 Mercury Contamination of Subsistence Fisheries on Tribal Lands

EPA's ORD partnered with EPA Region 8 and the Cheyenne River Sioux Reservation to complete a three-year study of mercury contamination in subsistence fisheries on tribal lands. The Cheyenne River Sioux Tribe Department of Environmental Protection (CRST DEP), EPA ORD's Environmental Response Team, and EPA Region 8 investigated mercury levels in fish tissues from the Cheyenne River and Lake Oahe in South Dakota.

In 2000, CRST released a fish advisory recommending less consumption of fish. The fish advisory was public, but specifically targeted pregnant women, children, and elderly members within the community. As a part of the fish advisory, CRST recommended consumption of fish from livestock ponds, which showed no influence from mining-related activities and presumably had lower concentrations of mercury in fish tissue. However, fish from livestock ponds with seemingly similar outward appearances had significant differences in mercury accumulation in both the same species or within species of the same trophic position. As a result, CRST learned that more in-depth studies of contaminated fish tissue were needed in order to protect tribal members from the harmful health effects related to consumption of various fish.

The goals of this ongoing project involving the Ecosystems Research Division of ORD's NERL are to determine the source and dominant pathways of methyl-mercury bioaccumulation in fish tissue and to make risk management recommendations to tribal members to reduce mercury exposures. Also, sampling of biotic and environmental media during the characterization phase of this project will be used to support the application of the EPA's Watershed Characterization System (WCS) and Mercury Cycling Model (MCM).

EPA and tribal personnel completed an initial comprehensive sampling effort in the summer of 2002. Mercury was detected in soil samples across the region, and high levels of methyl-mercury were found in aquatic invertebrates, including caddisflies and copepods. Methyl-mercury concentrations were 110 ppb in caddisflies and 810 ppb in copepods. Region 8 personnel also have utilized atmospheric deposition sampler systems on-site to characterize the source term of loadings to the ponds and surrounding watersheds. Initial results confirm high levels of methyl-mercury in aquatic food webs; communities dominated by predatory zooplankton are much more contaminated than ponds dominated by herbivorous plankton (Cladocerans). Smaller ponds appear to be at greater risk for greater methyl-mercury bioaccumulation.

Sample collection is ongoing in order to support the development of a model to fully characterize the fate and transport of mercury and its biomagnification in the managed aquatic ecosystems of the Sioux Tribe.

Program contact: Dr. John M. Johnston, EPA, ORD, NERL, Ecosystems Research Division, 960 College Station Road, Athens, GA, 30605-2700, 706-355-9153, johnston.johnm@epa.gov, or www.epa.gov/athens/.

4.2 Other Risk Communication Efforts to Protect Human Health

4.2.1 The Centers for Disease Control and Prevention Reports on Mercury

Reports and Fact Sheets

The CDC publishes reports containing risk information pertaining to toxic chemicals and metals, including mercury. Of the several documents that discuss the importance of preventing human health exposure to toxic substances, including mercury, CDC's report "Blood and Hair Mercury Levels in Young Children and Women of Childbearing Age — United States, 1999" states that the U.S. population primarily is exposed to methyl-mercury by eating fish (CDC 2001a). Exposure to methyl-mercury results in adverse human health effects, and pregnant women, women of childbearing age, and young children are the most sensitive populations. Pregnant women and women of childbearing age pass on the adverse human health effects of methyl-mercury to their unborn fetuses. Data reported by the NHANES 1999 effort are subject to the following three limitations: (1) the ratio of mercury in cord and maternal blood is uncertain; (2) NHANES cannot provide estimates of mercury exposure in certain highly sensitive groups, such as subsistence fishermen and others who eat large amounts of fish; and (3) the sample size of the NHANES 1999 effort was small and the 1999 survey was conducted in only 12 locations. Please see Appendix E for data sampling results.

Clearinghouses and Databases

CDC also is continuing its NHANES research efforts in order to study the human health effects of mercury and several other toxic chemicals. The table in Appendix E presents preliminary estimates of blood and hair mercury levels from the 1999 NHANES data. According to the 1999 NHANES data, mercury levels in young children and women of childbearing age generally are below those considered hazardous, and approximately 10 percent of women have mercury levels within one tenth of potentially hazardous levels. The long-term strategy for reducing exposure to mercury is to lower concentrations of mercury in fish by limiting mercury releases into the atmosphere from burning mercury-containing fuel and waste and from other industrial processes.

NHANES is the only national source of objectively measured health data capable of providing accurate estimates of both diagnosed and undiagnosed medical conditions in the population. NHANES represents a unique collaboration between CDC, the National Institutes of Health (NIH), and others to obtain data for biomedical research, public health, tracking of health indicators, and policy development.

Program contact: Kenneth W. Harris, National Center for Health Statistics, Division of Data Services, 3311 Toledo Road, Hyattsville, MD 20782, 301-458-4636, rdca@cdc.gov, or www.cdc.gov/nchs/nhanes.htm.

4.2.2 Agency for Toxic Substances and Disease Registry Public Health Statements and Fact Sheets

ATSDR and EPA jointly issue public health statements and fact sheets describing the effects of mercury. ATSDR describes mercury as a hazardous chemical that can cause serious health problems, and children, as well as fetuses, are most vulnerable. Mercury exposure also is common for persons using certain folk medicines or participating in certain ethnic or religious practices. Therefore, communicating these exposure scenarios, whether short-term or long-term, and the resulting human health effects is extremely important.

ATSDR explains in the public health statements and fact sheets issued to the public that human exposure to mercury can result from eating fish containing methyl-mercury. ATSDR lists other sources as well, including:

- Breathing vapors from spills, incinerators, and industries that burn mercury-containing fuels.
- Exposure to releases of mercury from dental work and medical treatments.
- Breathing contaminated air or skin contact in the workplace, such as dental offices, health services, and chemical plants.
- Practicing rituals that include mercury.

More information on these sources and other mercury exposure and risk communication information are outlined in the ATSDR's ToxFAQsTM and March 1999 Public Health Statement for Mercury (see the following text box).

Program contact: ATSDR Information Center, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333, 1-888-422-8737, ATSDRIC@cdc.gov.

What Information Does ATSDR Provide on Methyl-mercury Exposure from Fish Consumption?

Some people may be exposed to higher levels of mercury in the form of methyl-mercury if they have a diet high in fish, shellfish, or marine mammals (whales, seals, dolphins, and walruses) that come from mercury-contaminated waters. Methyl-mercury accumulates up the food chain, so that fish at the top of the food chain will have the most mercury in their flesh. Of these fish, the largest (i.e. the oldest) fish will have the highest levels. The FDA estimates that most people are exposed, on average, to about 50 ng of mercury per kilogram of body weight per day (50 ng/kg/day) in the food they eat. This is about 3.5 micrograms (µg) of mercury per day for an adult of average weight. This level is not thought to result in any harmful effects. A large part of this mercury is in the form of methyl-mercury and probably comes from eating fish. Commercial fish sold through interstate commerce that are found to have levels of methyl-mercury above an "action level" of 1 ppm (established by the FDA) cannot be sold to the public. This level itself is below a level associated with adverse effects. However, if you fish in contaminated waters and eat the fish you catch, you may be exposed to higher lev-

els of mercury. Public health advisories are issued by state and Federal authorities for local waters that are thought to be contaminated with mercury. These advisories can help non-commercial (sport and subsistence) fishermen and their families to avoid eating fish contaminated with mercury. Foods other than fish that may contain higher-than-average levels of mercury include wild game, such as wild birds and mammals (bear) that eat large amounts of contaminated fish. People in the most northern climates may be exposed to high levels of mercury from eating meat or fat from marine mammals including whales, dolphins, walruses, and seals. These marine mammals are at or near the top of their marine food chain. Plants contain very little methyl-mercury or other forms of mercury. Mushrooms grown in mercury-contaminated soil may contain levels of mercury that could pose some risk to health, if large amounts were eaten.

4.2.3 FDA Advisories on Methyl-mercury and Fish Consumption

FDA issued a consumer advisory in 1994 on methyl-mercury and fish consumption. On January 12, 2000, FDA revised its consumer advisory to include the following: (1) several recent, large-scale studies of methyl-mercury exposure in human populations[2]; (2) recent data regarding fish consumption and mercury concentration; (3) the health benefits of a balanced diet that includes fish; and (4) feedback from focus groups that reacted to different types of consumer messages.[3] FDA set out to maintain a public message that was simple, direct, understandable, and easy-to-follow. The revised advisory focused on specific fish to "avoid" and specific fish considered "safe" to eat. The original and revised advisories were directed primarily toward pregnant women and women of childbearing age to protect developing unborn children from excessive exposure to methyl-mercury during pregnancy. The revised consumer advisory is shown in the following text box (FDA 2001a).

The FDA revised advisory recommends that pregnant women and women of childbearing age who may become pregnant avoid identified fish species with the highest average amounts of methyl-mercury. FDA also added king mackerel and tilefish to the list of fish types that should be avoided. FDA's previous advisory listed only shark and swordfish. FDA, in its revised advisory, gave the same general recommendation of fresh or frozen tuna and canned tuna as general fish types having lower methyl-mercury concentrations. This recommendation indicates that even the at-risk population can safely eat 12 ounces per week of most types of cooked fish. Canned tuna is one of the most popular fish consumed by the majority of the fish-eating population. However, according to the National Food Processors Association, as well as FDA, the consumption of canned tuna at the highest level (the 99th percentile) is approximately 7 ounces per week, and therefore harmful exposure to a developing unborn child was not likely at this rate. Finally, the average methyl-mercury level in fresh or frozen tuna is only a third of that found in shark and swordfish and is actually closer to the level for canned tuna. FDA's revised advisory also addresses nursing women and their young children in order to protect the developing nervous system of newborns. See Appendix F for tables providing means and ranges for mercury in fish and shellfish.

Program contact: FDA, Center for Food Safety and Applied Nutrition, 5100 Paint Branch Parkway, College Park, MD, 20740-3835, 1-888-SAFEFOOD, or www.cfsan.fda.gov.

Consumer Advisory, Center for Food Safety and Applied Nutrition, U.S. Food and Drug Administration, March 2001: An Important Message for Pregnant Women and Women of Childbearing Age Who May Become Pregnant About the Risks of Mercury in Fish

Seafood can be an important part of a balanced diet for pregnant women. It is a good source of high-quality protein and other nutrients and is low in fat. However, some fish contain high levels of a form of mercury called methyl-mercury that can harm an unborn child's developing nervous system if eaten regularly. By being informed about methyl-mercury and knowing the kinds of fish that are safe to eat, you can prevent any harm to your unborn child and still enjoy the health benefits of eating seafood.

How Does Mercury Get Into Fish? Mercury occurs naturally in the environment, and it can also be released into the air through industrial pollution. Mercury falls from the air and can get into surface water, accumulating in streams and oceans. Bacteria in the water cause chemical changes that transform mercury into methyl-mercury that can be toxic. Fish absorb methyl-mercury from water as they feed on aquatic organisms.

How Can I Avoid Levels of Mercury That Could Harm My Unborn Child? Nearly all fish contain trace amounts of methyl-mercury, which are not harmful to humans. However, long-lived, larger fish that feed on other fish accumulate the highest levels of methyl-mercury and pose the greatest risk to people who eat them regularly. You can protect your unborn child by not eating these large fish that can contain high levels of methyl-mercury:

- Shark
- Swordfish
- King mackerel
- Tilefish

While it is true that the primary danger from methyl-mercury in fish is to the developing nervous system of the unborn child, it is prudent for nursing mothers and young children not to eat these fish as well.

[2] These studies included research efforts from the Seychelles, Faroes, and New Zealand.

[3] In addition to new methyl-mercury data and feedback from focus groups, FDA also reviewed its original consumer advisory based on the publication of the congressionally mandated National Academy of Sciences/National Research Council (NAS/NRC) report, *Toxicological Effects of Methyl-mercury, National Academy of Sciences, 2000*. Also, in response to the NAS/NRC report, the Environmental Protection Agency revised the RfD so that it was identical to the recommendations provided in the NAS/NRC report.

Is It All Right to Eat Other Fish? Yes. As long as you select a variety of other kinds of fish while you are pregnant or may become pregnant, you can safely enjoy eating them as part of a healthful diet. You can safely eat 12 ounces per week of cooked fish. A typical serving size of fish is from 3 to 6 ounces. Of course, if your serving sizes are smaller, you can eat fish more frequently. You can choose shellfish, canned fish, smaller ocean fish or farm-raised fish—just pick a variety of different species.

What if I Eat More Than 12 Ounces of Fish a Week? There is no harm in eating more than 12 ounces of fish in one week as long as you don't do it on a regular basis. One week's consumption does not change the level of methyl-mercury in the body much at all. If you eat a lot of fish one week, you can cut back the next week or two and be just fine. Just make sure you average 12 ounces of fish a week.

Some kinds of fish are known to have much lower-than-average levels of methyl-mercury and can be safely eaten more frequently and in larger amounts. Contact your Federal, state, or local health department or other appropriate food safety authority for specific consumption recommendations about fish caught or sold in your local area.

What About the Fish Caught By My Family or Friends in Fresh Water Lakes and Streams? Are They Safe to Eat? There can be a risk of contamination from mercury in fresh waters from either natural or industrial causes that would make the fish unsafe for you or your family to eat. The Environmental Protection Agency provides current advice on fish consumption from fresh water lakes and streams. Also check with your state or local health department to see if there are special advisories on fish caught from waters in your local area.

4.2.4 Northeast Waste Management Official's Association Mercury Program

The Northeast Waste Management Officials' Association (NEWMOA) is a nonprofit, nonpartisan interstate association that has a membership composed of the hazardous waste, solid waste, waste site cleanup and pollution prevention program directors for environmental agencies in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. NEWMOA was established by the governors of the New England states as an official regional organization to (1) coordinate interstate hazardous waste, solid waste, and pollution prevention activities; (2) support statewide waste programs; and (3) help states articulate, promote, and implement economically sound regional programs for the enhancement of environmental protection. The association was formally recognized by EPA in 1986.

NEWMOA supports a Mercury Program and dedicates a portion of the NEWMOA web site, www.newmoa.org, to mercury program areas. These program areas cover several mercury issues and exposure prevention approaches, not necessarily inclusive of outreach activities that focus on consumption of contaminated fish. Major elements of the mercury web page include background information on environmental issues related to mercury, links to other mercury resources, and documents and reports available for public use. The web site lists the following information resources to help the NEWMOA states achieve their goal of mercury elimination and reduction.

Reports and Fact Sheets

Instructions for Cleaning Up "Small" Mercury Spills in Households. This seven-page report informs the public on the proper way to clean and handle small spills or other incidents involving mercury within the household. It contains basic clean-up instructions for a small liquid mercury spill, as well as a table of references for reporting mercury spills and receiving professional assistance and disposal guidance within the northeastern states, including Connecticut, Maine, New Hampshire, Massachusetts, New York, New Jersey, Rhode Island, and Vermont.

The Mercury in Schools and Communities initiative has sparked a host of information brochures, reports, and fact sheets for the public. The following resources contain information on identifying and removing elemental mercury and products containing mercury from schools and from homes.

Getting Mercury Out of Schools: Why It's a Problem. Where It Is. What to Do, a series of individual fact sheets for specific school staff members (e.g., facilities manager, science chairperson, medical personnel) on the items that may contain mercury typically found in those areas.

Identification of Mercury Devices in Schools, a table to assist school staff and/or state and local technical assistance providers in identifying mercury materials commonly found in schools. Specific tables are available for science rooms, medical offices, and school facilities.

Case Study on Mercury Elimination from Bay Path Vocational Technical High School, Charlton, Massachusetts, a case study that describes a local effort to identify and eliminate elemental mercury and products containing mercury from facilities.

Eight Good Ideas for Reducing Mercury Exposure and Pollution in your Community, a six-page pamphlet that was developed to assist municipal officials.

Nearly Everything You Need to Know About Mercury Fever Thermometer Exchanges, a web page document that provides many ideas for conducting and publicizing an exchange on the risks of mercury fever thermometers, including a sample public service announcement, press release and poster.

Reported Mercury Spills in the Northeast States. This twelve-page report includes publicly available data compiled from environmental and public health agencies in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont on the occurrence of spills of mercury. The report features several tables that list the number of occurrences in each state.

Clearinghouses and Databases

The Interstate Mercury Education and Reduction Clearinghouse (IMERC). This clearinghouse provides ongoing technical and programmatic assistance to states that have enacted provisions of the Mercury Education and Reduction Model Legislation. It provides a single point of contact for industry and the public for information on mercury-containing products and wastes and mercury education and reduction programs of member states. Copies of the Model Legislation are available at www.newmoa.org/prevention/mercury/final_model_legislation.htm. IMERC also has made available the Mercury Education Video, an instructional video that provides background information on mercury and the environment, as well as IMERC.

Mercury-added Products Database. This database presents information submitted to IMERC on the amount and purpose of mercury in consumer products. The database is intended to inform consumers, recyclers, policy makers and others about products that contain intentionally added mercury, the amount of mercury in a specific product, the amount of mercury in a specific product line sold in the U.S. in a given year, and manufacturers of mercury-added products.

Mercury Topic Hub. The Mercury Topic Hub project includes five hubs that cover general mercury issues, mercury thermometers, mercury thermostats, mercury in dental clinics, and metal fabrication and machining. The general Mercury Hub provides background on the issues related to mercury including health effects, releases to the atmosphere, mercury in products, mercury in the environment, and fish advisories. It also covers the spectrum of assistance and regulatory approaches focused on mercury reduction, as well as Federal, state, and local mercury reduction programs.

Mercury-Reduction Programs Database. This database includes descriptions of mercury-reduction programs underway around the U.S. and profiles each project. For each project, the database lists a brief description, the title, list of products affected, program results, sources of funding, and contact information.

Program contact: Terri Goldberg, NEWMOA, 129 Portland Street, 6th floor, Boston, MA 02114, 617-367-8558 x302, tgoldberg@newmoa.org, or www.newmoa.org.

4.2.5 United Nations Environmental Programme's Global Mercury Assessment

The United Nations Environment Programme (UNEP) published a Global Mercury Assessment report in December 2002. The report responds to a request of the Governing Council of UNEP to undertake a global assessment of mercury and mercury compounds. The report was written with members of the Inter-Organization Programme for the Sound Management of Chemicals (IOMC).

The report indicates that there are significant global adverse impacts from mercury and its compounds, and further international action should be taken to reduce the risks to human health and the environment. As a result, national, regional and global actions should be initiated as soon as possible. In the report, the Governing Council of UNEP urged all countries to adopt goals and take national actions to identify exposed populations and ecosystems and reduce anthropogenic mercury releases that impact human health and the environment. The Governing Council also requests that UNEP initiate technical assistance and capacity-building activities to support countries in these mercury-reduction efforts, particularly developing countries and countries with economies in transition.

At the Governing Council's regular session in February 2005, members reviewed progress made in taking action against mercury pollution and considered the need for further measures for addressing the significant global adverse impacts of mercury and its compounds. The Governing Council also considered what further action might be taken with regard to other heavy metals, such as lead and cadmium.

Program contact: United Nations Environment Programme, The Secretary for Governing Council, P.O. Box 30552, Nairobi, Kenya, (254 2) 623431/623411, beverly.miller@unep.org, or www.unep.org/GC/GC23/.

4.2.6 U.S. Geological Survey Mercury Research

USGS provides information on toxic chemicals, including metals such as mercury, through its Toxic Substances Hydrology (Toxics) Program. The Toxics Program was initiated in 1982 and established to provide scientific information on the behavior of toxic substances in the nation's hydrologic environments. The Toxics Program reports on contamination of surface water, groundwater, soil, sediment, and the atmosphere by toxic substances. The Toxics Program conducts intensive field investigations and regional investigations of contamination affecting aquatic ecosystems from nonpoint and distributed point sources. The Toxics Program is coordinated with EPA, the U.S. Department of Agriculture (USDA), the Department of Defense (DOD), the Department of Energy (DOE), the Nuclear Regulatory Commission (NRC), the Department of Interior (DOI), and other agencies.

The following subsections describe specific USGS efforts that resulted in reports or fact sheets communicating the environmental and human health risk of mercury from fish consumption.

Reports and Fact Sheets

Mercury Contamination of Aquatic Ecosystems. USGS completed this fact sheet to describe new trends in the investigations of mercury pollution. Recent fish-sampling surveys have shown widespread mercury contamination in streams, wetlands, reservoirs, and lakes in the U.S. States have issued fish consumption advisories (FCAs) because of mercury contamination. See Appendix G for USGS sampling data. The document discusses the effects of mercury bioaccumulation, human health effects of mercury toxicity, ways that mercury enters the food chain, the conversion of inorganic mercury to methyl-mercury, and other topics related to mercury contamination.

A National Pilot Study of Mercury Contamination of Aquatic Ecosystems along Multiple Gradients: Bioaccumulation in Fishes. This report was written by William G. Brumbaugh, David P. Krabbenhoft, Dennis R. Helsel, and James G. Wiener and was presented at the 21st annual meeting of the Society of Environmental Toxicology and Chemistry (SETAC) in Nashville, Tennessee, November 12-16, 2000. This report described the national pilot study that examined the relationship between mercury and methyl-mercury in aquatic ecosystems. The study involved sampling events of water, sediment, and fish in the summer and fall of 1998 at 106 stations from 20 U.S. watershed basins.

Mercury bioaccumulation in fishes was strongly (positively) correlated with the mercury concentration in water, but only moderately correlated with the mercury in sediment or the total mercury in water. Of the other measured parameters, pH, dissolved organic carbon (DOC), sulfate, sediment loss on ignition (LOI), and the percent wetlands of each basin were also significantly correlated with mercury bioaccumulation in fishes. The best model for predicting mercury bioaccumulation included mercury in water, pH of the water, percent wetlands in the basin, and the acid-volatile sulfide (AVS) content of the sediment. Generally, high concentrations of mercury in water will yield high concentrations in fish. Based on rankings by various mercury criteria, sampling sites from the following five study units had the greatest mercury contamination: Nevada Basin and Range, South Florida Basin, Sacramento River Basin (California), Santee River Basin and Coastal Drainages (South Carolina), and the Long Island and New Jersey Coastal Drainages.

Are Walleye from Lake Roosevelt Contaminated with Mercury? This fact sheet studied the effects of mercury on walleye and other sport fish from the upper Columbia River and Franklin D. Roosevelt Lake (Lake Roosevelt). Based on this report, scientists discovered that walleye had higher concentrations of mercury than other sport fish, and larger walleye had higher mercury concentrations than smaller walleye. Researchers also discovered that mercury concentrations in walleye fillets ranged from 0.11 to 0.44 ppm. After reviewing these findings, the Washington State Department of Health concluded, "...people who regularly consume large amounts of Lake Roosevelt walleye may be at risk of adverse health effects from mercury and should limit their consumption of these fish." The fact sheet also emphasized that most mercury in fish is methyl-mercury, a highly toxic substance that can build up in predatory fish, such as walleye, swordfish, and tuna, and in animals that eat these fish. Methyl-mercury can damage the brain, nervous system, and kidneys. The risk is probably very low for adults who eat fish only occasionally. The risk is greatest for developing fetuses, children, and people who depend on sport fish for food. Mercury also threatens the health of fish-eating wildlife such as loons, eagles, otters, and raccoons. Also, mercury-contaminated sport fish may adversely affect a local economy that depends on recreational fishing. In addition, the fact sheet listed the recommended maximum consumption rates of walleye from Lake Roosevelt. See Table 4-1.

Table 4-1. Recommended Maximum Consumption of Walleye from Lake Roosevelt

Adults	Pregnant Women and Women in Childbearing Years	Children Under 6 Years of Age
4 pounds per month	1 pound per month	1/3 pound per month
8 meals per month	2 meals per month	

Research Initiatives

National Assessment of Mercury in Aquatic Ecosystems. USGS heads this initiative to study aquatic ecosystems across the nation to identify the factors that control where and when mercury accumulates to toxic levels in the food chain. Ecosystems with varying source intensity (e.g., mining, natural, and atmospheric sources) and varying potential to convert mercury to its most toxic form, methyl-mercury, are being tested. A total of 112 sites are undergoing synoptic sampling of water, sediment, and fish, and samples have been analyzed for mercury and the more toxic form of mercury, methyl-mercury. Additionally, USGS plans to determine if the widespread mercury problem is a result of current mercury emissions into the atmosphere or if it is due to mercury deposition resulting from past activities and occurrences.

Program contact: U.S. Geological Survey, Toxic Substances Hydrology Program, http://toxics.usgs.gov/regional/mercury.html.

METAALICUS. The scientific community's current understanding of the fate of mercury in the environment cannot guarantee or provide reasonable assurance that significant environmental improvements would result from reduced emissions of mercury. To address this concern, an international team of researchers that includes scientists from the USGS is conducting the METAALICUS experiment. With METAALICUS, researchers will add specific mercury isotopes to an entire watershed to assess the atmospheric loading of mercury in Canada and the U.S. The results of this experiment will allow the research team to determine precisely how much and how quickly recently added mercury enters food webs. This experiment will provide the control necessary to examine the effects of the one critical factor in examining mercury contamination, mercury loading, and furthermore will also allow scientists to distinguish newly deposited mercury from background mercury that has accumulated over hundreds of years.

Mercury is the most common contaminant in fish in the U.S. and Canada. Forty-two states have advisories against fish consumption due to high mercury levels, and unacceptable fish mercury concentrations exist in all Canadian provinces and the Northwest Territories, including remote "pristine" lakes. Of closures to fishing in Ontario, 97 percent are due to mercury contamination.

As a part of METAALICUS, mercury inputs to headwater lakes and their watersheds will be increased experimentally, and mercury will be added as stable, non-radioactive isotopes of inorganic mercury [Hg(II)]. An ecosystem

approach will be used because the complex pathway of mercury from the atmosphere to fish cannot be simulated in laboratory experiments. Movement of the mercury and transformations between mercury forms will be followed through watersheds and lakes, and production of methyl-mercury will be studied in lake sediments, uplands and wetlands. Scientists also will study the bioaccumulation of methyl-mercury in benthic organisms, plankton and fish.

The study will be carried out in two phases over a five-year period, and a final report and publication of the study will be drafted in 2004.

Program contact: Reed Harris, Tetra Tech Inc., 905-339-0763, harrisr@idirect.com or Dr. John Rudd, Canadian Department of Fisheries and Oceans (DFO), and the Freshwater Institute, 501 University Crescent, Winnipeg, MB R3T 2N6, Canada, 204-983-5240, ruddj@dfo-mpo.gc.ca., or www.biology.ualberta.ca/metaalicus//metaalicus.htm.

Aquatic Cycling of Mercury in the Everglades (ACME). The ACME project is an interagency, multidisciplinary study to recognize the primary mercury-cycling pathways in the Everglades and to synthesize these pathways with a "model" for restoration and predictive purposes. The goal of this project is to describe the mercury contamination problem in South Florida. For most aquatic ecosystems, atmospheric deposition is the primary source of mercury, although there are numerous instances of geologic and anthropogenic point-source contamination. There are many sources of mercury to the atmosphere, both natural and human related. Natural sources include outgassing from the oceans, volcanoes, and natural mercury deposits. Coal combustion, waste incineration, chlor-alkai production, and metal processing are the dominant human-related sources to the atmosphere. In ecosystems for which atmospheric deposition is the dominant source, resulting concentrations of total mercury in water are very low, generally less than 10 nanograms per liter (ng/L).

The challenge to scientists is to explain the series of processes that lead to toxic or near-toxic levels of mercury in organisms near the top of the food chain (bioaccumulation), when aqueous concentrations and source-delivery rates are so low. To understand this phenomenon adequately, scientists must apply an interdisciplinary approach in which various components of an ecosystem (atmosphere, biota, surface water, groundwater, and sediments) are studied contemporaneously. The purpose of this fact sheet is to describe the mercury contamination problem in South Florida and the interdisciplinary project that was assembled under the auspices of the USGS South Florida Ecosystem Program to investigate the underlying processes that cause mercury bioaccumulation.

In response to this request from resource managers for more scientific information on mercury cycling in the Everglades, the USGS South Florida Ecosystem Program, South Florida Water Management District (SFWMD), and EPA are co-funding a group of scientists to study mercury bioaccumulation in the Everglades. Participating scientists are from several agencies, including USGS, SFWMD, Florida Department of Environmental Protection, EPA, Wisconsin Department of Natural Resources, and University of Wisconsin-Madison. The overall objective of this project is to provide resource managers scientific information on the hydrologic, biologic, and geochemical processes controlling mercury cycling in the Everglades. It is anticipated, however, that information from this project will be transferable to other ecosystems where mercury problems arise. Specific areas of research among the group includes geochemical studies of mercury, mercury methylation and demethylation studies, DOC-mercury interactions, mercury accumulation in sediments, diagenetic processes in peat, sulfur-cycling studies, biological uptake of mercury and lower food chain transfer pathways, and groundwater/surface water exchange.

Program contact: David Krabbenhoft, USGS, 8505 Research Way, Middleton, WI 53562, 608-821-3843, dpkrabbe@usgs.gov, William H. Orem, USGS, 12201 Sunrise Valley Drive, Reston, VA 20192, 703-648-6273, borem@usgs.gov, George Aiken, USGS, 3215 Marine Street, Boulder, CO 80303, 303-541-3036, graiken@usgs.gov, Carol Kendall, USGS, 345 Middlefield Road, MS 434, Menlo Park, CA 94025, 650-329-4576, ckendall@usgs.gov, or http://sofia.usgs.gov/projects/evergl_merc/.

Mercury Studies Team. The USGS Water Resources Division, Wisconsin District, has formed a Mercury Studies Team to provide (1) expert assistance to the USGS and other state and Federal agencies in the form of scientific understanding of mercury in the environment; (2) methods for collecting mercury samples in various media (e.g., water, sediment, biota); and (3) analytical support by maintaining a state-of-the-art mercury analysis laboratory. The Team seeks to obtain high-quality projects through cooperative agreements, development of project proposals, execution of the project work elements, and timely completion of reports. Also, the Mercury Studies Team continues to maintain a good level of challenging work that will sustain the professional and financial needs of the team.

Program contact: David P. Krabbenhoft, USGS, 8505 Research Way, Middleton, WI 53562, 608-821-3843, dpkrabbe@usgs.gov, or http://infotrek.er.usgs.gov/mercury/.

USGS Mercury Research Lab. As a part of the Mercury Studies Team, USGS supports the Mercury Research Lab in the Wisconsin District. Mercury has been recognized as an environmental pollutant for several decades. The laboratory provides unbiased data for the support of mercury research projects. Support includes training of personnel in proper collection techniques, providing sampling equipment, development of new collection and analytical methods, analysis and reporting of high-quality results from various matrices and mercury species, and consultation in project development and interpretation of results.

Program contact: David P. Krabbenhoft, USGS, 8505 Research Way, Middleton, WI 53562, 608-821-3843, dpkrabbe@usgs.gov, or http://infotrek.er.usgs.gov/doc/mercury/mercury_research_lab.html.

5.0 Case Studies: Developing and Using Data Visualization and Data Interpretation Tools

5.1 Introduction

This chapter shows how four particular FCA programs have successfully used a variety of data visualization and data interpretation tools, often integrating several tools into their programs. All of these FCA programs rely in part on their web sites, in addition to other tools, for effective risk communication. Understanding how these programs use this wide range of risk communication tools "in real life" will hopefully be useful to other programs that are considering developing or expanding their own risk communication services.

Section 5.6 of this chapter presents a discussion of some of the challenges that can be encountered when communicating FCA information, particularly when the audience includes avid fishers, subsistence fishers, or Native Americans.

5.2 State of Minnesota Program

5.2.1 Program Background

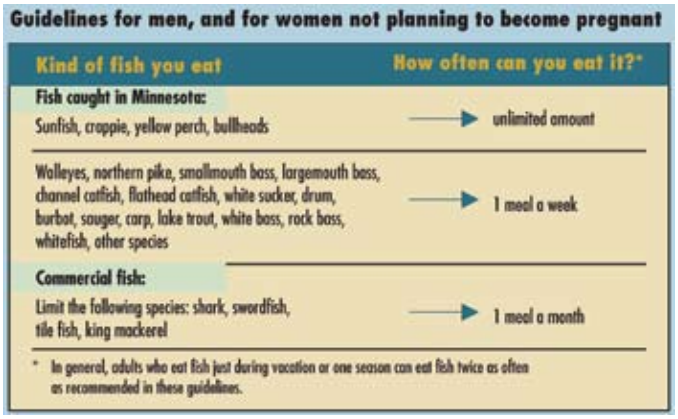
The Minnesota Department of Health (MDH) administers the FCA program in the state. Each spring, MDH releases its annual FCA. This advisory provides guidelines on how much fish people can safely consume while minimizing their risks from contaminants such as mercury. In Minnesota, over 90 percent of the advisories to limit consumption are based on levels of mercury (MDH 2003b).

5.2.2 Effective Methods

The MDH FCA program successfully integrates several risk communication tools, including traditional printed materials, community presentations, and a web site. These tools provide information that is easy to understand for people with little prior knowledge about the risks associated with consumption of fish contaminated with mercury. The following subsections describe some of the risk communication tools used by MDH.

Outreach Materials

MDH publishes the FCA in an eight-page brochure titled "Eat Fish Often?" Excerpts from this brochure are shown in Figures 5-1 and 5-2. The tables shown in Figure 5-1 are also provided with the fishing regulations. The MDH "Eat Fish Often?" brochure is included in Appendix H.



Guidelines for men, and for women not planning to become pregnant

Kind of fish you eat	How often can you eat it?*
Fish caught in Minnesota:	
Sunfish, crappie, yellow perch, bullheads	unlimited amount
Walleyes, northern pike, smallmouth bass, largemouth bass, channel catfish, flathead catfish, white sucker, drum, burbot, sauger, carp, lake trout, white bass, rock bass, whitefish, other species	1 meal a week
Commercial fish:	
Limit the following species: shark, swordfish, tile fish, king mackerel	1 meal a month

* In general, adults who eat fish just during vacation or one season can eat fish twice as often as recommended in these guidelines.

Figure 5-1. General Population Fish Chart
Reference: Minnesota Department of Health, "Eat Fish Often?" A Minnesota Guide to Eating Fish, March 2006.

Guidelines for pregnant women, women planning to become pregnant and children under age 15

Kind of fish you eat	How often can you eat it?*
Fish caught in Minnesota:	
Sunfish, crappie, yellow perch, bullheads	1 meal a week
Walleyes shorter than 20 inches, northern pike shorter than 30 inches, smallmouth bass, largemouth bass, channel catfish, flathead catfish, white sucker, drum, burbot, sauger, carp, lake trout, white bass, rock bass, whitefish, other species	1 meal a month
Walleyes longer than 20 inches, northern pike longer than 30 inches, muskellunge	Do not eat.
Commercial fish:	
• Shark, swordfish, tile fish, king mackerel	Do not eat.
• Other commercial species, including canned tuna	See MDH's brochure, *"An Expectant Mother's Guide to Eating Minnesota Fish."*

* These guidelines apply even if eating fish just during a vacation or for just one season.

Figure 5-2. Special Population Fish Chart
Reference: Minnesota Department of Health, "Eat Fish Often?" A Minnesota Guide to Eating Fish, March 2006.

MDH also has a separate publication that provides additional information for women of childbearing age and children; "An Expectant Mother's Guide to Eating Minnesota Fish" is available in both English and Spanish. Both MDH brochures are included in Appendix H. More detailed, site-specific recommendations are available online at www.health.state.mn.us. Detailed recommendations are also available in the Lake Sur-

vey Reports produced by the Minnesota Department of Natural Resources (DNR) (MDH 2003b).

MDH has reduced the amount of printed risk communication materials that it publishes, partly for budget reasons. Currently, the only printed materials available are "Eat Fish Often?" and "An Expectant Mother's Guide to Eating Minnesota Fish." Printed materials formerly included fact sheets and more detailed, site-specific recommendations. The more detailed recommendations for eating fish from lakes and rivers that have been tested for contaminants can now be obtained only online at www.health.state.mn.us.

MDH also produces a fish magnet, shown in Figure 5-3, which has been found to be a very popular item that makes the public aware of the MDH FCA program (MDH 2003a).

Presentations

MDH formerly prepared printed materials for people of Southeast Asian descent. It was found, however, that verbal communication is more successful for this target group, so MDH now provides information through presentations at community events instead. These presentations are generally conducted in cooperation with DNR (MDH 2003a).

Web Site

The MDH web site is located at www.health.state.mn.us. As shown in Figure 5-4, the MDH web site includes an easily accessible link to "Fish Consumption Advice."

The MDH web site includes downloadable versions of the documents currently in publication, plus tables containing fish consumption guidelines for specific species and water bodies. The MDH environmental health web site also provides information on recent news regarding mercury (MDH 2003b).

5.2.3 Key Accomplishments

MDH was one of the first organizations to implement a comprehensive FCA program, and the MDH program has been successfully used as a template for many other state programs.

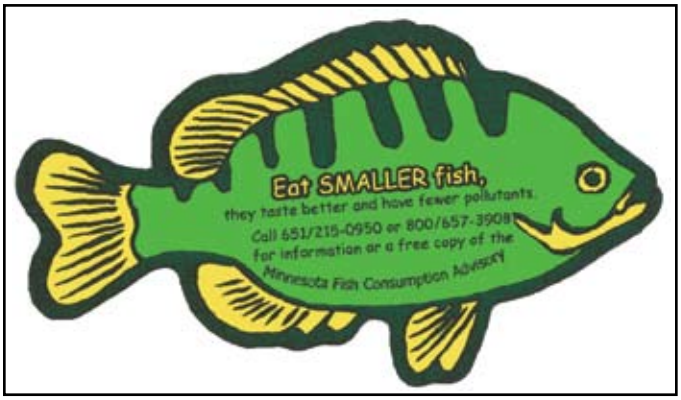


Figure 5-3. Minnesota Department of Health Fish Magnet
Reference: MDH 2005.

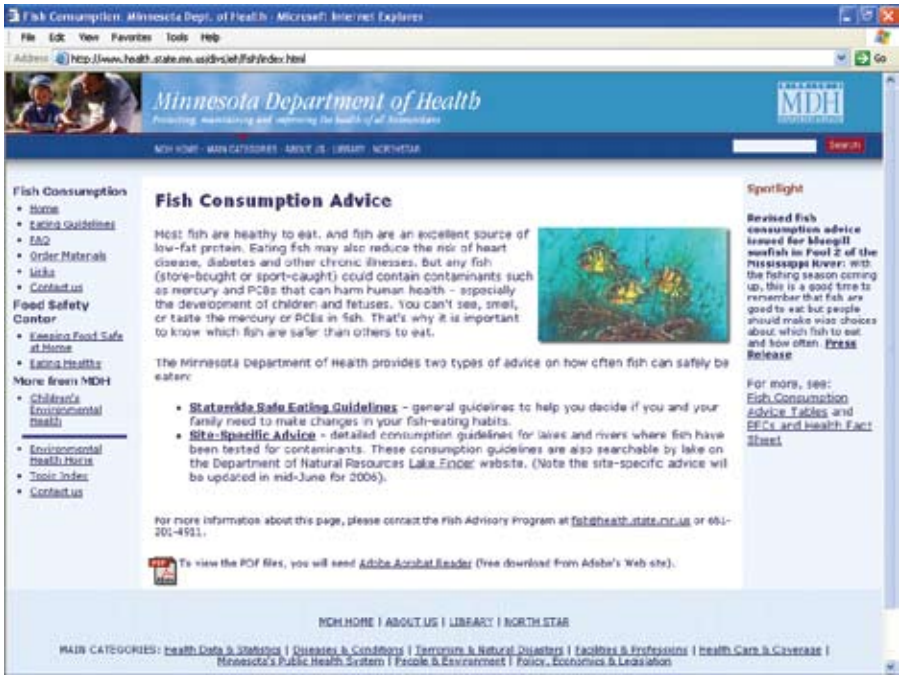


Figure 5-4. Minnesota Department of Health Web Site

MINNESOTA MDH DEPARTMENT OF HEALTH

March 2006

Fish Consumption Advisory Materials

Please indicate the number of copies you want next to the items listed, below.

Brochures

_____ **Eat Fish Often? A Minnesota Guide to Eating Fish** Our new annual advisory brochure. Contains health-based advice on eating fish from lakes and rivers in Minnesota. March 2006 (IC# 141-0378)

_____ **An Expectant Mother's Guide to Eating Minnesota Fish** What you should know if you are pregnant, planning a pregnancy, or nursing a baby. For use in clinical or childbirth education, and by consumers. March 2006. (IC# 141-0709)

_____ **Spanish Version of An Expectant Mother's Guide to Eating Minnesota Fish** March 2006 (IC# 141-0059)

Magnet

_____ 2x4 magnet. "Eat smaller fish, they taste better and have fewer pollutants" (IC# 399-0406)

Limit of 300 per organization

Please print or type the **street address** for delivery of your order.

Name_____

Organization_____

Street Address_____

City_____ State_____ Zipcode_____

Telephone # _____

Fax this form to MDH at (651) 201-4606; or **mail** it to us at:

Fish Consumption Advisory
Minnesota Department of Health
P.O. Box 64975
St. Paul, MN 55164-0975

Questions?
Contact the Minnesota Fish Consumption Advisory program at (651) 201-4911, or, in Greater Minnesota, 1-800/657-3908, and press 1. To request this document in another format, call (651) 201-5000, TDD (651) 201-5797. Permission is given to photocopy the materials listed on this form.

Figure 5-5. Minnesota Department of Health Order Form for FCA Materials
Reference: MDH 2006.

5.2.4 Lessons Learned

In developing and implementing its FCA program, MDH has learned some valuable lessons that have contributed to its success:

- MDH has found that cooperation with other groups and organizations improves communication and effectiveness. For example, as previously stated, MDH and DNR jointly provide presentations to community groups.
- MDH has also found that FCA materials can be disseminated most efficiently and cost-effectively through cooperation with other groups and organizations. For example, "An Expectant Mother's Guide to Eating Minnesota Fish" is primarily distributed through health care providers, local public health agencies, and the Women, Infants, and Children (WIC) Program. The WIC Program is administered by the Food and Nutrition Service, a Federal agency of the USDA. MDH FCA materials are also distributed through DNR and the Minnesota Pollution Control Agency (MPCA), as well as some businesses, state parks and community organizations. Every spring, MDH sends an order form to all distributors. The order form used in 2006 is shown in Figure 5-5 and is also included in Appendix H (MDH 2006).

Before MDH established statewide safe-eating guidelines, some members of the public had the false impression that no contaminants should be present in fish from waterbodies not included in published lists. Since testing indicates that all fish caught in Minnesota contain mercury at some level, MDH established the statewide safe-eating guidelines published in "Eat Fish Often?" to provide general guidance for commonly consumed fish. The statewide safe-eating guidelines are primarily based on typical mercury levels in fish caught throughout Minnesota (MDH 2006).

5.2.5 Future Plans

MDH continues to work to improve the effectiveness of its FCA program. Addressing comments from the public is one way in which this is accomplished. MDH also continues to add information to its web site.

In the future, MDH would like to expand on its guidance to include more information on the benefits of eating fish and risks to be considered when consuming commercial fish.

5.3 State of New York Program

5.3.1 Program Background

The fish advisories program in the State of New York is administered by the New York State Department of Health (NYSDOH) Center for Environmental Health. Within the NYSDOH Center for Environmental Health, the fish advisories program is administered cooperatively by the Bureau of Toxic Substance Assessment and the Outreach and Education Group. The Bureau of Toxic Substance Assessment focuses on the technical content, and the Outreach and Education Group focuses on communicating information to the public.

5.3.2 Effective Methods

The NYSDOH fish advisories program successfully integrates several risk communication tools, including traditional printed materials, signs posted at fishing areas, and a web site. These tools provide information that is relatively easy to understand for people with little prior knowledge about the risks associated with consumption of fish contaminated with mercury. The following subsections describe some of the risk communication tools used by NYSDOH.

Outreach Materials

Fish advisory outreach materials published by NYSDOH for New York State include a 32-page booklet, "2005-2006 Health Advisories: Chemicals in Sportfish and Game," and a two-page brochure, "Eating Sport Fish" (available in English and Spanish). NYSDOH also publishes a tri-fold brochure for the New York City Reservoir System, "2005-2006 Health Advisories on Eating Sportfish." The two brochures are included in Appendix I; the booklet can be downloaded from the NYSDOH web site at www.health.state.ny.us/nysdoh/fish/fish.htm (NYSDOH 2005-2006).

Also, the New York State Department of Environmental Conservation (NYSDEC) includes the fish advisories information in its "Fishing Regulations Guide," which is distributed with fishing licenses (NYSDEC 2005-2006).

In 1999, NYSDOH developed a number of promotional items designed to increase public awareness of its fish advisories program. Funding for these promotional materials was provided through two grants: the Hudson River Fish Advisories Outreach and Education Program, funded by EPA, and the Great Lakes Consortium Sportfish Advisory Program, funded by ATSDR through the State of Wisconsin. The promotional items were a poster, a tote bag, a T-shirt, a bandana, a magnet, a memo pad, and a children's book cover. The magnet and the tote bag are shown in Figures 5-6 and 5-7, respectively. The promotional items were distributed through a network of community organizations. This promotional campaign also included public service announcements broadcast on radio in English and Spanish (NYSDOH undated). Contaminants of concern in the Hudson River are PCBs, but outreach approaches and the methods chosen for raising awareness could be applied to other contaminants.

Figure 5-6. New York State Department of Health Fish Magnet.

Figure 5-7. New York State Department of Health Tote Bag.

Web Site

NYSDOH fish advisory information is available online at http://www.health.state.ny.us/nysdoh/fish/fish.htm. This informative web page includes a link to the FDA advisory regarding mercury contamination in fish and also contains contact information for related agencies and organizations. The NYSDOH booklet, "2005-2006 Health Advisories: Chemicals in Sportfish and Game," can be downloaded from this web page (NYSDOH 2005-2006). Fish advisory information provided by NYSDOH is also featured prominently on the NYSDEC web site.

5.3.3 Key Accomplishments

When developing fish advisory signs to post along the Hudson River, NYSDOH performed focus group testing to increase the likelihood that the signs would effectively communicate fish advisory information to the target audience. The NYSDOH documented its focus group testing results in a report titled "Hudson River Fish Advisories Outreach and Education Project: The Sign Development Process." This report explains that "two clearly divergent perspectives emerged" during the focus group discussions. The white male groups consistently expressed the perspective that the message presented on the signs should be "very short and non-threatening, with a graphic that would attract people who fish." The focus group of African-Americans and Latinos, however, felt that the message presented on the signs should be "very strong, highlight individuals most at risk, and provide a graphic that would be informative for people with low literacy skills" (NYSDOH 1999).

Based on the widely divergent results obtained during focus group testing, NYSDOH decided to produce two different signs, one to be posted north of the Catskill Bridge where fish contain higher levels of contaminants and one to be posted south of the bridge where contaminant levels are lower. Figure 5-8 shows the sign posted north of the Catskill bridge; Figure 5-9 shows the sign posted south of the Catskill bridge (NYSDOH 1999).

5.3.4 Lessons Learned

In developing and implementing its fish advisories program, NYSDOH has learned some valuable lessons that have contributed to the success of the program:

- As discussed in Subsection 5.3.3, cultural differences affect how people perceive risks associated with fish. It is therefore important that the message on a given sign is appropriate for the local community, as well as being appropriate for the contamination level of the fish found in the posted body of water.
- NYSDOH has found that cooperation with local organizations improves communication and effectiveness. This cooperation maximizes resources, but more importantly, it makes it possible to develop risk communication materials that are the best possible "fit" for each community. Within a given community, NYSDOH works with one or more groups that provide expertise regarding how fish advisory information is best communicated in that community.
- NYSDOH has also found that fish advisory information can be disseminated most efficiently and cost-effectively through cooperation with other groups and organizations. For example, NYSDOH provided fish advisory training to nutritionists employed by the WIC Program, who were then able to convey this information to women of childbearing age. NYSDOH also worked with the WIC Program to develop fish advisory text for a WIC newsletter.

When working with local groups, NYSDOH feels that its primary role is to ensure that fish advisory information is communicated accurately (ensuring, for example, that local groups do not convey a "do not eat the fish you catch" message unless required by the local situation).

5.3.5 Future Plans

Ongoing efforts at NYSDOH include working with more individual communities to develop appropriate signage for their waterbodies.

NYSDOH is currently evaluating the results of interviews it conducted during the summer of 2002. NYSDOH received funding from the ATSDR Great Lakes Consortium Sportfish Advisory Program. This funding was used to conduct one-on-one interviews with nearly 400 people across the state to learn how the public perceives the messages that NYSDOH is trying to convey. The interviews targeted a cross-section of the New York State population and included the use of Spanish and Russian translators to allow effective communication. After NYSDOH completes its analysis of the interviews, it plans to use these results to improve communication.

NYSDOH recently provided assistance with a grant proposal developed and submitted by the W. Haywood Burns Environmental Education Center. This center is an environmental

Figure 5-8. New York State Department of Health FCA Sign, North Catskill Bridge
Reference: NYSDOH 1999.

Figure 5-9. New York State Department of Health FCA Sign, South Catskill Bridge
Reference: NYSDOH 1999.

justice group that works in an African-American community in Albany, NY, and is extremely active in raising awareness of fish advisories in its community. If the W. Haywood Burns Environmental Education Center obtains this grant, the group plans to hire someone from within the community to spend time out on the water talking with fishers and conveying fish advisory information.

5.4 Great Lakes Indian Fish and Wildlife Commission Program

5.4.1 Program Background

The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) is "an agency of eleven Ojibwe nations in Minnesota, Wisconsin, and Michigan with off-reservation treaty rights to hunt, fish and gather in treaty-ceded lands" (GLIFWC web site). In 1991, the Biological Services Division of GLIFWC began testing walleye for mercury contamination. By 1995, tribal leaders directed the division to perform additional walleye testing and provide test results to tribal members in a user-friendly manner. In 1996, they received a grant from ATSDR through the Ojibwe Health Study, and the funding was used to test walleye from numerous lakes. The resulting data were used to develop maps showing mercury concentrations in walleye collected from lakes in which tribal members fish. These maps have been revised several times to improve their user-friendliness (GLIFWC 2003).

5.4.2 Effective Methods

GLIFWC's set of maps showing mercury concentrations in walleye from area lakes serves as the basis for the FCA program. The maps are designed to be relatively easy to understand and use. The following subsections describe the maps and other risk communication tools used by GLIFWC.

GLIFWC Maps

GLIFWC has developed maps for six regions, which visually convey the mercury concentrations observed in walleye from lakes harvested by the following six tribes: Bad River, Lac Courtes Oreilles, Lac du Flambeau, Mole Lake, Red Cliff, and St. Croix. There are two maps for each region: one map for sensitive populations (pregnant women, women of childbearing age, and children under 15 years old) and one for other individuals (women beyond childbearing age and men). Figure 5-10, on page 26, shows the two maps for the lakes harvested by Lac Courtes Oreilles; the map for the sensitive populations is presented at the top and the map for other individuals is presented in the bottom portion of Figure 5-10. The complete set of maps is included in Appendix J and can be obtained from the GLIFWC web site at www.glifwc.org.

GLIFWC selected inland lakes and walleye for the mercury fish advisory based on the fact that tribal members use traditional methods to harvest walleye each spring from scores of lakes within the ceded territories, and walleye make up over 95 percent of the fish harvested (Krueger 2003). In addition, based on a five-year study of fish consumed by tribal members, approxi-

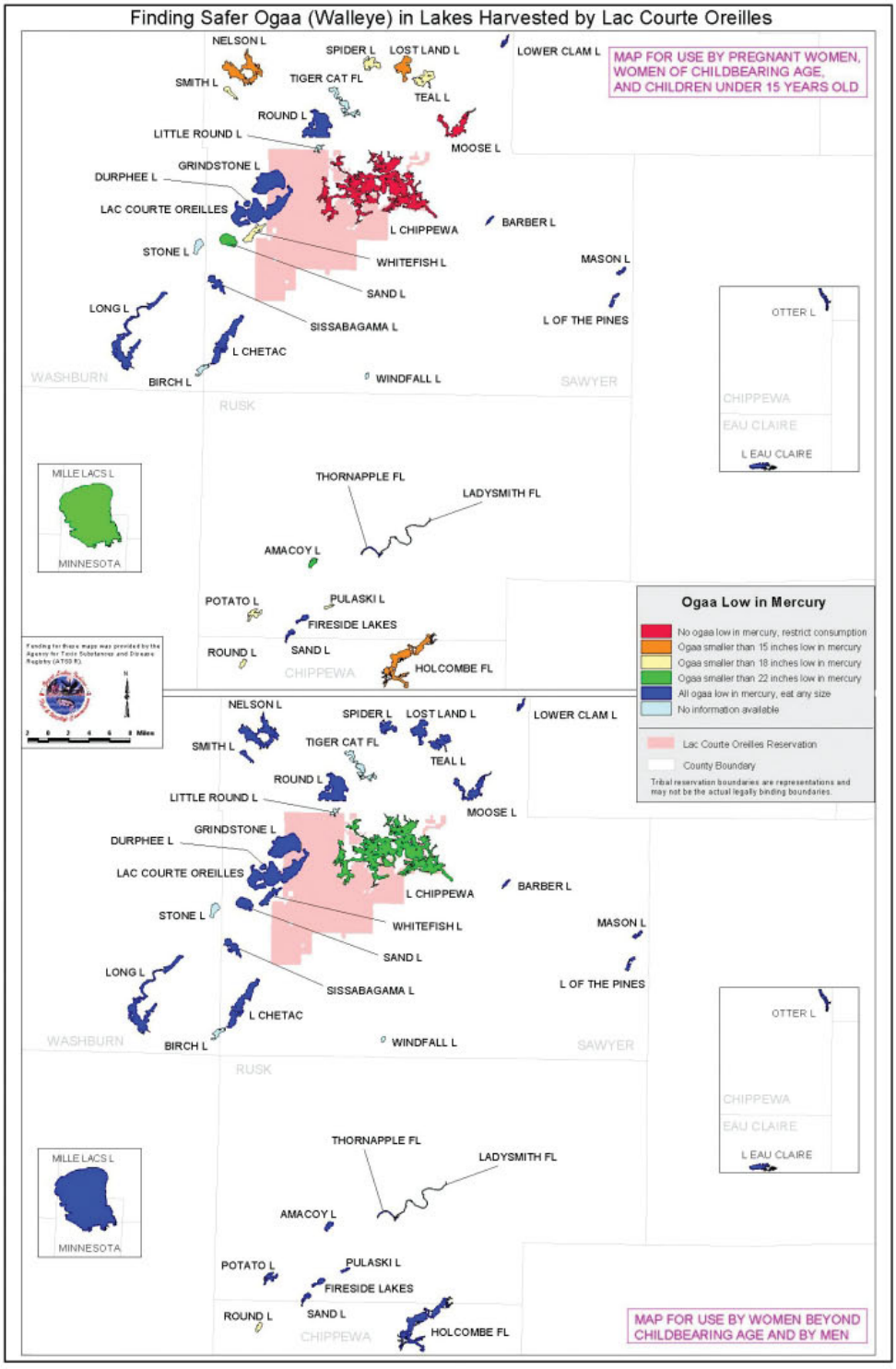


Figure 5-10. Great Lakes Indian Fish and Wildlife Commission Maps of Lakes Harvested by Lac Courtes Oreilles
Reference: GLIFWC Web Site, www.glifwc.org.

mately 60 percent of the fish consumed were walleye, and 80 percent of the fish consumed were top predator fish (GLIFWC 2003).

In developing the maps for the sensitive populations, GLIFWC defined walleye "low in mercury" as those containing less than 0.5 milligrams of mercury per kilogram of fish. In the maps for other individuals, walleye "low in mercury" are defined as those containing less than 1 milligram of mercury per kilogram of

fish. These levels were selected based on the state of Wisconsin fish consumption guidance available when the maps were developed. (The data used in the maps are from GLIFWC and the State of Wisconsin, via a cooperative agreement.) In 2001, the State of Wisconsin revised its guidance to incorporate EPA's current RfD; the GLIFWC maps have not yet been updated to reflect this new guidance. GLIFWC has applied for funding to be used to update the maps to incorporate EPA's RfD for mercury in fish (GLIFWC 2003).

The maps use an intuitive color-coding scheme. For example, red, which is commonly understood to signify "stop" or "danger," is used for lakes in which walleye of all sizes have been found to contain mercury at concentrations above those considered acceptable for consumption. Blue is used for lakes in which walleye of all sizes have been found to contain only low concentrations of mercury. Additional clearly differentiated colors (orange, yellow, and green) indicate lakes in which walleye of various specified sizes have been found to contain mercury at concentrations above those considered acceptable for consumption.

"Spearer" Meetings

A portion of the tribal members participate in spearfishing. The spearfishing is highly organized by the tribes, which hold "spearer" meetings before each walleye season begins. Upon a tribe's request, a representative of the GLIFWC Biological Services Division attends these meetings to provide information and distribute maps to all spearers. When the spearers catch fish, they share it with other tribal members. Since the spearers are provided with information regarding mercury contamination in fish, they can distribute this information to the other tribal members while they are sharing the fish they have caught (GLIFWC 2003).

Web Site

The GLIFWC maps are easily accessible online at www.glifwc.org.

5.4.3 Key Accomplishments

Many fish advisories publish limits on food intake using very specific sizes, amounts, and frequencies. GLIFWC has tried to avoid this because fish consumption is such a major component of tribal culture. Therefore, GLIFWC's goal is to inform tribal members so that they can make choices to reduce their risks. The maps are a good tool for this, since tribal members can reduce their risks by choosing fish from lakes in which the fish contain lower levels of mercury. GLIFWC is also working to convey the message that large predator fish contain more contaminants than smaller fish (GLIFWC 2003).

The map shown at the top of Figure 5-10 provides an excellent illustration of the fish consumption choices available to the Lac Courtes Oreilles tribal members. The lakes immediately adjacent to the Lac Courtes Oreilles reservation include Lac Courtes Oreilles and Lake Chippewa. As shown in Figure 5-10, Lac Courtes Oreilles is a "blue lake." Data indicate that all walleye from this lake contain only low concentrations of mercury. Lake Chippewa, however, is a "red lake." Data indicate that any size walleye from this lake can contain mercury at concentrations above those recommended for sensitive populations.

Numerous observations by GLIFWC staff indicate that the maps are being used by tribal members. For example, a tribal member was pleased to learn that he could once again consume walleye less than 18 inches from the Gile Flowage. He had avoided fishing that lake for several years because he had heard that the fish were too contaminated to safely eat (GLIFWC 2003).

5.4.4 Lessons Learned

- In general, tribal members consider mercury contamination in fish (and all other environmental issues) to be a serious matter, and FCA information spreads quickly within tribes. GLIFWC has therefore learned to communicate risks in a manner that allows tribal members to be informed so that they can react properly, without overreacting and unnecessarily impacting their culture.
- Obtaining funding through grants from other agencies and organizations is essential to GLIFWC's FCA program because this work is not included in GLIFWC's core mission funded by Congress.
- The tribal members are interested in the quality of the data used to develop the maps. While presenting information at spearer meetings, the GLIFWC Biological Services Division has received questions regarding the number of fish tested from each lake and how recently fish from a given lake have been tested.

5.4.5 Future Plans

GLIFWC has applied for funding from EPA's National Center for Environmental Research (NCER) Science to Achieve Results (STAR) Program. If received, this funding will be used to update the GLIFWC maps to incorporate EPA's RfD for mercury in fish. The grant would also be used to fund a study to evaluate and document the effectiveness of these maps in communicating risk-based information and the influence of these maps on the behavior of tribal members. GLIFWC would also expand its maps to include four more tribes, at which point maps will be available for 10 of the 11 member tribes.[4]

5.5 San Francisco Bay FCA and Risk Communication Program

5.5.1 Program Background

FCAs for California, including the San Francisco Bay, are issued by the California Environmental Protection Agency (Cal/EPA) Office of Environmental Health Hazard Assessment (OE-

[4] The eleventh tribe would not be included because members of that tribe fish almost exclusively in Lake Superior, and a different inter-tribal organization evaluates that lake (GLIFWC 2003).

HHA). OEHHA works in cooperation with other agencies and organizations to communicate San Francisco Bay FCA information to the public. This cooperation is vital to the success of the program, especially since the San Francisco Bay is surrounded by nine different counties and has hundreds of fishing locations. The California Department of Health Services (CDHS) is particularly involved in these outreach efforts.

5.5.2 Effective Methods

One unique aspect of the San Francisco Bay Program is the extent to which OEHHA and CDHS have worked to evaluate the effectiveness of FCA communication efforts. This case study focuses on the surveys that have been performed to evaluate the public response to FCA information.

OEHHA Angler Survey

In December 1993, OEHHA issued a revised FCA for striped bass in San Francisco Bay, based on mercury levels. Based on recommendations from an advisory task force, OEHHA also developed multilingual signs to inform the public of the advisory. In October 1994, these signs were posted at Berkeley Pier and Dumbarton Pier. In June and July 1995, OEHHA performed a survey at the Berkeley public fishing pier to evaluate the effectiveness of the signs and to assess anglers' general awareness of contaminants in fish from San Francisco Bay. The results of this survey are published in an OEHHA report titled "Angler Survey: Analysis of Sign Effectiveness and Angler Awareness of San Francisco Bay Fish Consumption Advisory" (Cal/EPA 1997).

Each of the signs posted in 1994 was 24 inches by 36 inches and contained text in English, Spanish, Chinese, Vietnamese, Cambodian, and Korean. The English text was as follows (Cal/EPA 1997):

WARNING

STRIPED BASS IN THE BAY CONTAIN MERCURY, A CHEMICAL THAT CAN CAUSE HEALTH PROBLEMS.

DO NOT EAT STRIPED BASS OVER 35 INCHES LONG.

CHILDREN UNDER 6 YEARS, PREGNANT AND NURSING WOMEN SHOULD EAT NONE AT ALL, OR NOT MORE THAN 1/2 LB. PER MONTH. THEY SHOULD NOT EAT ANY STRIPED BASS OVER 27 INCHES.

ADULTS SHOULD EAT NO MORE THAN 4 LBS. PER MONTH.

CHILDREN AGES 6-15 SHOULD EAT NO MORE THAN 2 LBS. PER MONTH.

During the 1995 survey, 520 anglers were interviewed using a prepared questionnaire. The interviewers included native speakers of all of the languages represented on the sign. Following is a summary of the responses obtained during the 1995 survey (Cal/EPA 1997):

- In total, 67.5 percent of the anglers reported having heard of or seen the FCA. Almost 54 percent of the anglers recalled exposure to the advisory without prompting, 11.5 percent reported seeing signs after general prompting, and 2.5 percent remembered seeing signs when asked specifically if they had seen the sign at the Berkeley pier. The remainder of the discussion in the report is based on the survey results from the 54 percent of anglers who recalled the advisory without prompting (referred to as the "first recall group").
- Awareness of the advisory came primarily from signs (39.9 percent), but also from newspapers (21.3 percent) and from friends (9.8 percent).
- Survey results indicated that most of the anglers who were aware of the advisory had a general understanding of its meaning.
- Only about 27 percent of anglers reported changing their eating habits based on the advisory. Interview results indicated that this low number was primarily because anglers had not previously caught or consumed striped bass in excess of the advisory limits. Survey results among anglers who changed their eating habits were "stopped eating certain kinds of bay fish" (31.5 percent), "eat more commercial fish" (12.3 percent), stopped eating fish entirely (8.2 percent), and stopped eating fish caught in the bay (8.2 percent). Only one angler reported preparing or cooking fish differently as a result of the warning.
- Just over one third of the anglers reported having been aware of the advisory or of pollution in the bay before seeing the sign. English-speaking anglers were more likely than others to report previous knowledge of the advisory.
- Many anglers reported having been surprised or concerned when they first saw the signs, and a few were angry.
- Anglers were also asked what they consider the best way of communicating fish advisories. The most popular answer was signs posted at fishing locations (26.7 percent), followed by television (17.1 percent), newspaper (13.1 percent), and radio (8.3 percent).
- Following the advice of fish advisories was seen as "very important" by 61.5 percent of the anglers, "important" by 24.9 percent, "not too important" by 10.4 percent, and "not important at all" by 2.7 percent of the anglers. English-speaking anglers gave more importance to following the advice of health advisories than did Spanish-speaking or Asian language-speaking anglers.

The angler survey report concludes that signs are an effective method for communicating FCA information, but that other communication methods are also important. The survey also demonstrates differences among ethnic groups in their views of advisories as well as their preferred communication methods. The report states that both of these findings are consistent

with the results of other surveys of this type and have important implications for future education and outreach programs (Cal/EPA 1997).

San Francisco Bay Seafood Consumption Study

In 1998, the San Francisco Bay Estuary Institute's Regional Monitoring Program funded the San Francisco Bay Seafood Consumption Study, which was performed by CDHS (CDHS 2001a and b). The results of this study are summarized in two fact sheets, "San Francisco Bay Seafood Consumption Study: General Information" and "San Francisco Bay Seafood Consumption Study: Information for People Who Fish." Both fact sheets were published in April 2001 and are included in Appendix K.

Before the study was performed, various efforts were made to communicate the most recent OEHHA FCA to the public. Communication efforts were coordinated through a task force, which included community-based organizations as well as state, county, and city agencies. The primary goal was to post signs in as many fishing areas as possible, since fishing access to San Francisco Bay is possible from a wide variety of locations. Some of these locations are state, county, or city facilities, such as public piers. Fishing access is also possible from privately owned marinas and other private facilities. To reach as many people as possible, the cities and counties surrounding San Francisco Bay were encouraged to post signs. Some local agencies used slightly different versions of the signs, but the overall message was coordinated through the task force. Community-based organizations also helped communicate fish advisory information by incorporating it into their materials and by sponsoring safe cooking fairs and other events (CDHS 2003).

The San Francisco Bay Seafood Consumption Study included interviews of over 1,300 anglers during a 12-month period in 1998 and 1999 (CDHS 2001a and b). Interviews were conducted at fishing locations, but not necessarily at locations where signs were posted (CDHS 2003). Each interviewer spoke English and at least one other language, such as Spanish, Vietnamese, Cantonese, or Mandarin. Following is a summary of the responses obtained during the study (CDHS 2001a and b):

- Of the anglers, 87 percent reported consuming fish from the bay. The ethnicity of these consumers was as follows: Caucasian (43 percent), Asian (30 percent), Latino (14 percent), and African-American (9 percent). (For the remaining 4 percent of the consumers, ethnicity was reported as "other" or was not reported.)
- The anglers who reported consuming fish from the bay were asked how much fish they consume. Following are survey results regarding the amount of fish from the bay consumed during the 4 weeks prior to the interview: 80 percent reported eating about one meal or less, 10 percent reported eating about two meals, and another 10 percent reported eating more than two meals.
- Of those who reported consuming fish from the bay, only 10 percent reported consumption levels above those recommended by the advisory. Those who reported exceeding the recommended consumption levels included anglers from all ethnic groups and backgrounds, but Asians and African-Americans were more likely to exceed the advisory levels.
- The highest fish consumption levels were reported by African-Americans and Filipinos; the lowest levels were reported by Caucasians.
- Of the anglers, 61 percent were aware of the advisory for the San Francisco Bay. However, "only 34 percent of anglers were aware of one or more of the recommendations in the health advisory, such as limiting how much fish they ate."
- Latino and Asian anglers were less likely to be aware of the advisory than were African-American or Caucasian anglers. Awareness of the advisory was found to be proportional to both income and education.

The San Francisco Bay Seafood Consumption Study recommended continued outreach and education efforts, including posting of additional signs. The study also recommended outreach "targeted toward anglers who eat more than the advisory recommends, or whose consumption habits place them at higher risk" (CDHS 2001a). Information from the San Francisco Bay Seafood Consumption Study was used during the development of new signs to communicate current advisory recommendations.

Advisory Signs

After completing the San Francisco Bay Seafood Consumption Study, CDHS worked with task forces and community groups to obtain input in the development of new advisory signs. This development process was completed in 2002. Figure 5-11, on page 30, shows the content of the new sign (the actual sign, however, is yellow, not the blue shown in Figure 5-11). The content of the sign is also included in Appendix K. Each sign is about 18 by 24 inches and is produced from flexible plastic. The California Department of Fish and Game funded the production of 1,000 signs costing $2.25 each.

The signs are being posted by the health offices of the nine counties surrounding the San Francisco Bay. The sign, as shown in Figure 5-11, includes an empty box in the lower right-hand corner. This space was left empty for each county to insert local information, including a telephone number for people to call if they have questions. CDHS distributed the signs with sheets of blank stickers so each county can print its own information stickers using a laser printer, then add a sticker to each sign in the empty box.

Web Site

The OEHHA web site, located at www.oehha.ca.gov/fish.html, includes numerous links and downloadable documents. The angler survey discussed in section 5.5.2 is one of the many documents that can be downloaded.

Figure 5-11. 2002 San Francisco Bay Sign
Reference: CDHS 2003 and California Environmental Protection Agency, Office of Environmental Health Hazard Assessment Web Site, www.oehha.ca.gov.

Each time OEHHA issues a new advisory, a fact sheet is developed to communicate this advisory to the public. For example, OEHHA has published guidelines for limiting consumption of fish from Lake Pillsbury, based on observed levels of mercury. This information is published in a report and summarized in a fact sheet, both of which can be downloaded from the OEHHA web site.

5.5.3 Key Accomplishments

As stated above, one unique aspect of the San Francisco Bay Program is the extent to which OEHHA and CDHS have worked to evaluate the effectiveness of FCA communication efforts. Both the angler survey and the San Francisco Bay Seafood Consumption Study included interviews of large numbers of anglers. The information obtained from these surveys and the associated studies has been used to improve the communication of FCAs, particularly in the development of signs posted at fishing areas.

5.5.4 Lessons Learned

By studying the effectiveness of the San Francisco Bay FCA program, OEHHA and CDHS have learned some valuable lessons (Cal/EPA 2003, CDHS 2003):

Task forces are helpful for allowing multiple groups and agencies to make the best use of whatever funding is available and to ensure that consistent information is being communicated to the public. However, even with task forces, communication is not perfect and there can be discrepancies in the information published by different groups and agencies.

Numerous other "lessons learned" from the angler survey and the San Francisco Bay Seafood Consumption Study are presented in Subsection 5.5.2.

5.5.5 Future Plans

OEHHA will continue to evaluate data received from multiple agencies and to develop FCAs for California. Ongoing OEHHA studies are reported on its web site at www.oehha.ca.gov. Other ongoing OEHHA efforts include presentations of information on advisories and chemical toxicity at public forums. OEHHA also holds public workshops for new advisories during which the public can comment on the advisories and on communication materials. OEHHA interacts with the fishing public at fairs and festivals, such as the Lake Oroville annual salmon festival, and provides demonstrations on healthy fish preparation methods while talking to the public about fish consumption and health. OEHHA is developing a fish consumption brochure for California in six languages and will continue to develop educational materials on safe consumption of fish.

After publishing the San Francisco Bay Seafood Consumption Study, CDHS received a small grant to work with four community-based organizations. CDHS passed this funding on to the organizations for their use in communicating FCA information. One organization developed materials in six Asian languages. Another organization developed a kit it could use during meetings regarding nutrition and health issues. CDHS continues to work with these organizations and has assisted them in writing a proposal for a grant to further this work.

CDHS is currently developing informational postcards in eight languages (a different postcard for each language). One of the postcard languages is Samoan because DHS received a request to provide information in Samoan, which is not included on the sign. One side of each postcard presents the same information presented on the sign. The other side of each postcard contains information regarding preparation and cooking of fish to minimize consumption of contaminants.

5.6 Risk Communication Challenges

Communication of FCA information holds numerous challenges, particularly when the audience includes avid fishers, subsistence fishers, or Native Americans. The position of one Native American group was presented by Dr. Stuart Harris during the 2001 National Forum on Contaminants in Fish, in his presentation titled "Impacts of Fish Contaminants on Native American Culture." The following summary of Dr. Harris's presentation is taken from the proceedings of that forum:

> Dr. Stuart Harris, of the Confederated Tribes of the Umatilla Indian Reservation, gave a personal account of the impacts on Native American culture resulting from fish contaminants and fish advisories. For his Columbia River Basin tribe, nearly 99 percent of the fish in the river are gone, and every remaining fish is contaminated to a greater or lesser extent. Dr. Harris described how his culture depends on exercising all the practices, activities, and lifestyles developed from a partnership with the ecology of the river system. He compares the impact on his culture of this loss of fishing and fish consumption with the loss of reading in the mainstream American culture. How would American lives change if people were asked to give up reading, and how would their lives change if a core attribute of mainstream culture were affected? Such is the loss for those Native American peoples whose culture has evolved in close association with the fish. While fish advisories may be needed, they are only useful as an interim short-term measure. EPA needs to set goals and take action in developing multimedia and watershed approaches to permitting. Losing fish means losing more than the health benefits of eating fish; it also means losing ceremonies, identity, and religion for Native American tribal peoples (Harris 2001).

The full text of Dr. Harris's presentation is included in Appendix L (Harris 2001).

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Appendix A:
Mercury in Fish

Conversion to methyl-mercury is the primary step in the introduction of mercury to the food chain. It occurs readily in both the water column and sediment. Fish absorb methyl-mercury from the water through their gills, and through consumption of aquatic organisms. Methyl-mercury then binds to the proteins in fish tissue. Most fish have concentrations of mercury between 0.01 and 0.50 parts per million (ppm). However, mercury increases in concentration as it moves up the food chain (also known as biomagnification). Therefore, larger predatory fish, such as shark, swordfish, certain species of tuna, pike, and walleye frequently have higher concentrations of mercury in their tissue (FDA 1994). Older fish also tend to have built up higher concentrations of mercury (NRC 2001) through the process of bioaccumulation. Bioaccumulation is defined as an increase in the concentration of a chemical in an organism over time, when compared to the chemical's concentration in the surrounding environment. This occurs when the chemical is taken up and stored faster than it is broken down or excreted (EXTOXNET 1993).

Appendix B:
Mercury in Motion

A. Transport and Transformation

Mercury is released to the atmosphere as elemental mercury and oxidized mercury. Elemental mercury has an average residence time in the atmosphere of one year, and can therefore be carried greater distances. Oxidized mercury generally has a residence time of hours to months and is deposited more locally or regionally. Elemental mercury can be transformed to oxidized mercury in cloud water, and is then subject to deposition to surface waters and land cover (U.S. EPA 1997c).

B. Deposition

Deposition of mercury from the atmosphere occurs as dry deposition and wet deposition. Dry deposition is the result of gravity on particulate or gaseous mercury oxides. Wet deposition occurs in precipitation as the result of the interaction of mercury and cloud water. Deposition onto soils results in a bonding of mercury to soil particles. Some mercury may be carried away in runoff or soil leachate. Mercury can enter water bodies through runoff or leachate from soil, and from direct deposition. Once in the water, mercury can remain in the water, settle into sediment, be taken up by aquatic biota, or revolatilize into the atmosphere. Revolatilization of mercury from the oceans is the primary source of re-emitted mercury (U.S. EPA 1997c).

Appendix C:
EPA's Reference Dose for Methyl-mercury

The BMD is a statistical lower confidence limit on the dose that produces a predetermined change in response rate of an adverse effect compared to background. The BMD was used rather than a no-observed-adverse-effect level/lowest observed-adverse-effect level (NOAEL/LOAEL) approach to analyze the neurological effects in children and the dose-effect relationship in the developmental studies used to derive the RfD. The current RfD was derived based on data from two longitudinal, developmental studies conducted in the Faroe Islands and New Zealand. The Faroe Islands study involved approximately 900 mother-child pairs. Maternal cord-blood mercury levels were measured during pregnancy. At 7 years of age, the children were then tested on a variety of tasks. The New Zealand study measured maternal hair mercury levels during pregnancy. The children of 38 women with mercury levels greater than 6 ppm during pregnancy were compared with the children of 199 mothers with lower hair mercury levels. At 6 years of age, the children were assessed on a number of standard neuropsychological endpoints. Both studies found developmental delays in children exposed in utero to methyl-mercury. Due to the larger sample size, emphasis was placed on the Faroe Islands study (U.S. EPA 2003a). The RfD is used for criterion development, EPA regulatory and risk management activities, and as the basis for fish consumption advisories (FCA) (Schoeny 2001). EPA used the K power model, considering the constraint K>1, for the BMD analysis, and the RfD for methyl-mercury is based on the neurotoxicological effects of methyl-mercury exposure (U.S. EPA 2003a).

The RfC for ionic mercury (elemental mercury) is 0.0003 mg/m^3. The RfC is analogous to the RfD and is based on the assumption that a threshold exists for toxic effects via inhalation (U.S. EPA 2003b). The RfD for mercuric chloride is 0.0003 mg/kg-day (U.S. EPA 2003c).

Appendix D:
Statewide Public Advisories

There were approximately 79,119 lakes (11,277,276 lake acres) and 485,205 river miles under fish advisory in 2001. Maryland, Missouri, North Dakota, and Pennsylvania each issued statewide advisories in 2001 for all lakes and rivers. Also in 2001, Alaska issued statewide "No Restriction" advice to inform the public that all Alaskan fish are safe to eat. Approximately 70 percent of the coastline of the lower 48 states are under an advisory, including 92 percent of the Atlantic Coast, 100 percent of the Gulf Coast, and several areas along the Pacific Coast (U.S. EPA 2002b). Figure D-1 highlights the states and percentage of lake acres/river miles in each state currently under advisory.

Several other states publish advisories for specific waterbodies only, rather than statewide advisories. A detailed explanation can be found in the U.S. EPA Office of Water, Fact Sheet - Update: National Listing of Fish and Wildlife Advisories, EPA-823-F-02-007, May 2002 (U.S. EPA 2002b).

Table D-1. Summary of 2001 Statewide Advisories by Waterbody Type

State	Waterbody Type		
	Lake	**River**	**Coastal Waters**
Alaska†	N/A	N/A	
Alabama			Mercury
Connecticut	Mercury	Mercury	PCBs
District of Columbia	PCBs	PCBs	
Florida			Mercury
Georgia			Mercury
Indiana		Mercury; PCBs	
Kentucky	Mercury	Mercury	
Louisiana			Mercury
Maine	Mercury	Mercury	Dioxins; Mercury; PCBs
Maryland	Mercury	Mercury	
Massachusetts	Mercury	Mercury	PCBs
Michigan	Mercury		
Minnesota	Mercury		
Mississippi			Mercury
Missouri	Mercury	Mercury	
New Hampshire	Mercury	Mercury	PCBs
New Jersey	Mercury	Mercury	PCBs; Cadmium; Dioxins
New York	PCBs; Chlordane; Mirex; DDT	PCBs; Chlordane; Mirex; DDT	Cadmium; Dioxins
North Carolina	Mercury	Mercury	Mercury
North Dakota	Mercury	Mercury	
Ohio	Mercury	Mercury	
Pennsylvania	Mercury	Mercury	
Rhode Island			PCBs
South Carolina			Mercury
Texas			Mercury
Vermont	Mercury	Mercury	
Wisconsin	Mercury		

Reference: U.S. EPA 2002b
†Alaska's statewide advice places no restrictions on consumption of fish or wildlife.

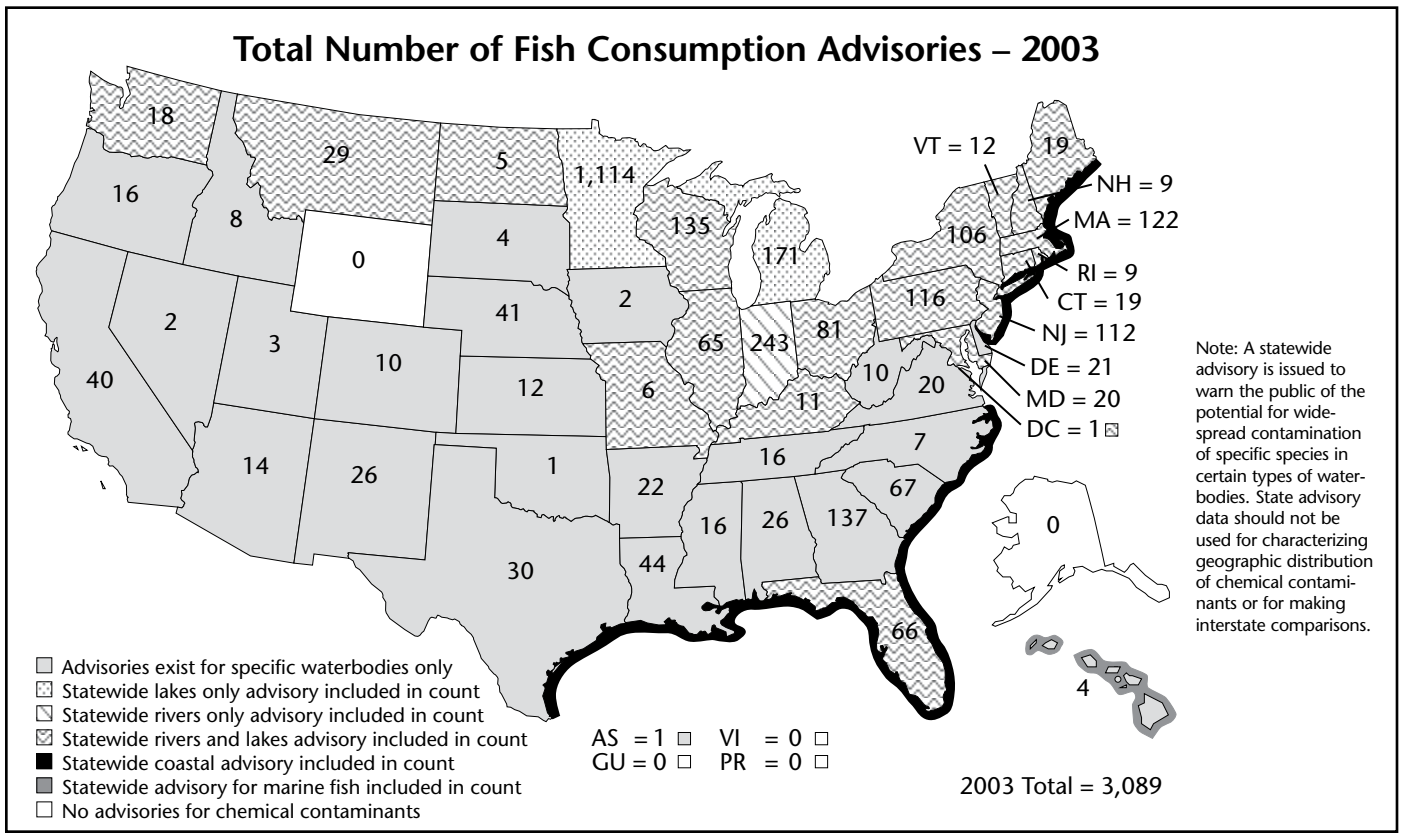


Figure D-1. Total Number of Fish Consumption Advisories for 2003.
Reference: U.S. EPA 2004b.

Appendix E:
Blood and Hair Mercury Concentrations by Age and Gender

Table E-1. Selected Percentiles and Geometric Means of Blood and Hair Mercury (Hg) Concentrations for Children Aged 1-5 Years and Women Aged 16-49 Years - NHANES, United States, 1999

	Geometric			Selected percentiles (95% CL*)				
	No.	Mean	(95% CL)	10th	25th	50th	75th	90th
Blood Hg (parts per billion)								
Children	248	0.3	(0.2-0.4)	<LOD§	<LOD	0.2 (0.2-0.3)	0.5 (0.4-0.8)	1.4 (0.7-4.8)
Women	679	1.2	(0.9-1.6)	0.2 (0.1-0.3)	0.5 (0.4-0.7)	1.2 (0.8-1.6)	2.7 (1.8-4.5)	6.2 (4.7-7.9)
Hair Hg (parts per million)								
Children	__**			<LOD	<LOD	<LOD	0.2 (0.1-0.4)	0.4 (0.3-1.8)
Women	__**			<LOD	<LOD	0.2 (0.2-0.3)	0.5 (0.4-0.8)	1.4 (0.9-1.7)

Reference: CDC 2001a
* CL, confidence level or interval, §Limit of Detection, _** Not calculated, proportion <LOD too high to be valid.

Appendix F:
Mercury Levels in Fish and Shellfish

The following tables provide the mean and range of mercury levels in a variety of fish and shellfish.

Table F-1. Fish with Highest Mercury Levels

Species	Mean (ppm)	Range (ppm)	No. of Samples
Tilefish	1.45	0.65-3.73	60
*Swordfish	1.00	0.10-3.22	598
King Mackerel	0.73	0.30-1.67	213
*Shark	0.96	0.05-4.54	324

Reference: FDA 2001b.
*Fish and shellfish among the most consumed of the domestic seafood market.
ND, non-detectable

Table F-2. Fish and Shellfish with Much Lower Mercury Levels

Species	Mean (ppm)	Range (ppm)	No. of Samples
Grouper (Mycteroperca)	0.43	0.05-1.35	64
Tuna (fresh or frozen)	0.32	ND-1.30	191
*Lobster Northern (American)	0.31	0.05-1.31	88
Grouper (Epinephelus)	0.27	0.19-0.33	48
*Halibut	0.23	0.02-0.63	29
*Sablefish	0.22	ND-0.70	102
*Pollock	0.20	ND-0.78	107
*Tuna (canned)	0.17	ND-0.75	248
*Crab Blue	0.17	0.02-0.50	94
*Crab Dungeness	0.18	0.02-0.48	50
*Crab Tanner	0.15	ND-0.38	55
*Crab King	0.09	0.02-0.24	29
*Scallop	0.05	ND-0.22	66
*Catfish	0.07	ND-0.31	22
*Salmon (fresh, frozen or canned)	ND	ND-0.18	52
*Oysters	ND	ND-0.25	33
*Shrimps	ND	ND	22

Reference: FDA 2001b.
*Fish and shellfish among the most consumed of the domestic seafood market.
ND, non-detectable

Table F-3. Fish with Methyl-mercury Levels Based on Limited Sampling

Species	Mean (ppm)	Range (ppm)	No. of Samples
*Red Snapper	0.60	0.07-1.46	10
Marlin	0.47	0.25-0.92	13
Moonfish	0.60	0.60	1
Orange Roughy	0.58	0.42-0.76	9
Bass Saltwater	0.49	0.10-0.91	9
Trout Freshwater	0.42	1.22 (max)	NA
Bluefish	0.30	0.20-0.40	2
Croaker	0.28	0.18-0.41	15
Trout Seawater	0.27	ND-1.19	4
*Cod (Atlantic)	0.19	ND-0.33	11
Mahi Mahi	0.19	0.12-0.25	15
*Ocean Perch	0.18	ND-0.31	10
Haddock (Atlantic)	0.17	0.07-0.37	10
Whitefish	0.16	ND-0.31	2
Herring	0.15	0.016-0.28	8
*Spiny Lobster	0.13	ND-0.27	8
Perch Freshwater	0.11	0.10-0.31	4
Perch Saltwater	0.10	0.10-0.15	6
Flounder/Sole	0.04	ND-0.18	17
*Clams	ND	ND	6
Tilapia	ND	ND	8

Reference: FDA 2001b.
*Fish and shellfish among the most consumed of the domestic seafood market.
ND, non-detectable

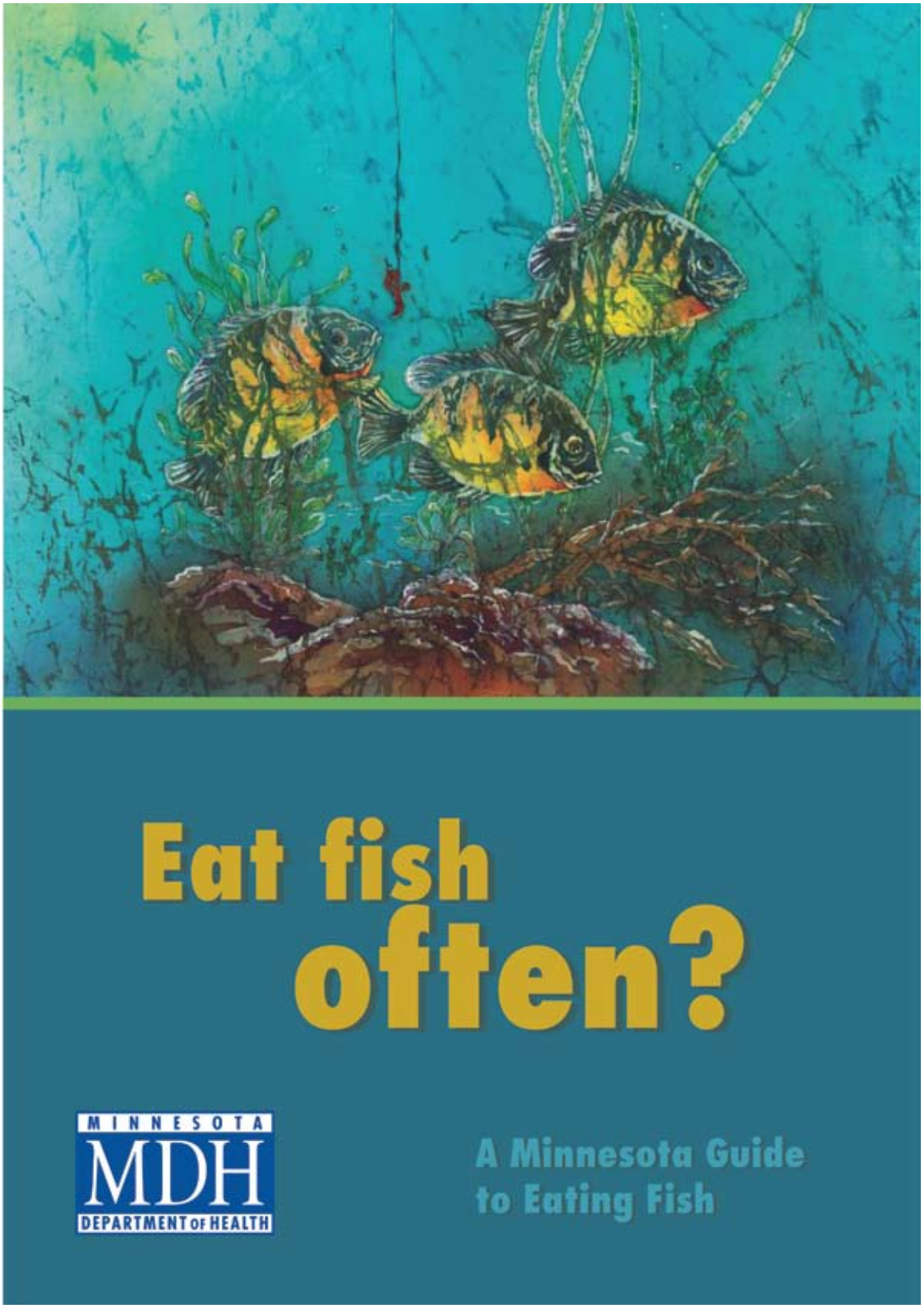
Appendix G:
Mercury Contamination of Aquatic Ecosystems

Table G-1. Fish Samples from USGS Study with Mercury Concentrations Greater than 0.5 ug/g wet wt.

Study Unit	Site Location	Species	Sample type (# of indiv.)	Mean wt. (g)	Mean Hg	Advisory[a]
NVBR	Lahontan Reservoir, NV	White Bass	Compos. (8)	694	3.36	Yes
SACR	Sacramento Sl. nr. Knights Landing, CA	Largemouth Bass	Individ. (1)	1471	2.17	No[b]
SOFL	Water Conservation District 3A15, FL	Largemouth Bass	Compos. (3)	788	2.15	Yes
SANT	N. Fork Edisto R.nr Fairview Crossrd, SC	Largemouth Bass	Individ. (1)	907	1.82	Yes
SACR	Bear River @ Hwy 70, CA	Largemouth Bass	Individ. (1)	518	1.21	No[b]
SACR	Bear River @ Hwy 70, CA	Smallmouth Bass	Individ. (1)	467	1.10	No[b]
LINJ	Great Egg Harbor @ Sicklerville, NJ	Chain Pickerel:H	Compos. (2)	172	0.91	Yes[c]
ACAD	Bogue Falaya R. @ Covington, LA	Largemouth Bass	Compos. (8)	–	0.83	Yes[d]
ACAD	Tangipahoa R. @ Robert, LA	Largemouth Bass	Compos. (8)	–	0.77	Yes[d]
YELL	Shoshone River, @ mouth nr. Kane, WY	Walleye	Compos. (5)	817	0.70	Yes
YELL	Bighorn Lake @ Hwy14A, WY	Walleye	Compos. (5)	896	0.68	Yes[e]
YELL	Bighorn River nr. Kane, WY	Walleye	Compos. (5)	452	0.66	No
YELL	Shoshone River @ mouth nr. Kane, WY	Walleye	Individ. (1)	1444	0.66	No
SACR	Sacramento Sl. nr. Knights Landing, CA	Largemouth Bass	Individ. (1)	1156	0.65	No
MOBL	Satilpa Creek nr. Coffeeville, AL	Spotted Bass	Compos. (2)	140	0.65	No
LINJ	Great Egg Harbor @ Sicklerville, NJ	Largemouth Bass	Individ. (1)	49	0.65	Yes
SANT	N. Fork Edisto River nr. Branchville, SC	Largemouth Bass	Individ. (1)	–	0.63	Yes
MOBL	Satilpa Creek nr. Coffeeville, AL	Largemouth Bass	Individ. (1)	92	0.62	No
LINJ	Great Egg Harbor @ Sicklerville, NJ	Chain Pickerel	Compos. (5)	84	0.59	Yes
SANT	S. Fork Edisto River @ Springfield, SC	Largemouth Bass	Individ. (1)	–	0.58	Yes
SANT	S. Fork Edisto River nr. Canaan, SC	Largemouth Bass	Individ. (1)	–	0.55	Yes
SOFL	Water Conservation District U3	Largemouth Bass	Compos. (3)	254	0.55	Yes
SACR	Bear River @ Hwy 70, CA	Smallmouth Bass	Individ. (1)	150	0.54	No[b]
MIAM	E. Fork L. Miami R. nr Wmsburg, OH	Smallmouth Bass	Individ. (1)	608	0.51	No

[a] Reference: U.S. EPA 1998
[b] Advisory by state of California pending (April 1999)
[c] Statewide advisory for bass and pickerel in New Jersey
[d] Statewide monitoring program for Hg in fish in progress.
[e] Advisory in effect for state of Montana but not Wyoming (April 1999)
—, No data

Appendix H:
MDH Outreach Materials



You already know that Minnesota is the *Land of 10,000 Lakes* and some excellent fishing.
But how much do you know about the fish that you eat?

Fish are an excellent food — they're a great source of protein, vitamins and minerals, and are low in saturated fat. Studies have shown that eating fish may help prevent heart disease in adults. **And most fish are healthy to eat.**

However, *any fish* (store-bought or sport-caught) could contain contaminants such as mercury or PCBs that could harm human health — especially the development of children and fetuses.

What should you do?

There's no need to stop eating fish. **But if you wish to reduce your exposure to contaminants, you need to make wise choices about the *kinds of fish* you eat and *how often* you eat fish.** Begin by checking the Safe Eating Guidelines in this brochure to see if you and your family need to make changes. By following these guidelines, you can reduce your exposure to the contaminants in fish, help reduce your health risks, and still get the benefits of eating fish.

Tips for reducing contaminants in fish

You can't see, smell or taste the mercury or PCBs in fish. That's why it's important to know which fish are safer than others to eat. Larger fish, older fish and fatty fish have higher amounts of contaminants. Fish that feed on other fish — such as walleyes, northern pike and bass — have the highest amounts of mercury in their meat.

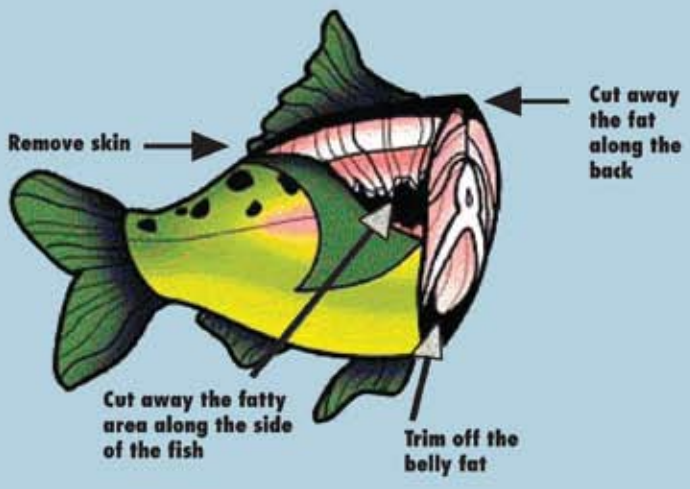
Remember the following tips when eating fish:

1. Eat smaller, younger fish.
2. Eat more panfish (sunfish, crappies) and fewer predator fish (walleyes, northern pike, lake trout).
3. Trim skin and fat, especially belly fat. Also, eat fewer fatty fish such as carp, catfish and lake trout. PCBs build up in fish fat. For instructions on cleaning and cooking fish properly, see page 4 in this brochure.

Cleaning and Cooking Fish

Clean and cook fish properly to deal with contaminants

Mercury cannot be removed through cooking or cleaning — it gets into the flesh of the fish. However, you can reduce the amount of other contaminants like PCBs by removing fat when you clean and cook fish.



For More Information

Minnesota Department of Health
Web site: www.health.state.mn.us/divs/eh/fish/index.html
Phone: 651/201-4911 or 1-800-657-3908
TDD for hearing impaired: 651/201-5797

Safe Eating Guidelines

The following Safe Eating Guidelines (provided in the two tables on pages 2 and 3) are based on mercury and PCB levels measured in fish throughout Minnesota and on levels of mercury found in commercial fish. Not all waters in Minnesota have been tested for contaminants in fish. But the Safe Eating Guidelines can be used for *both* tested and untested waters.

In addition to these general Safe Eating Guidelines, the Minnesota Department of Health also provides specific advice for lakes and rivers that have been tested. For the tested lakes and rivers, fish may contain higher- or lower-than-average levels of mercury or PCBs, and the resulting meal advice will be either more or less restrictive than the Safe Eating Guidelines below.

For specific lake and river advice, contact the Minnesota Department of Health at the phone numbers or Web site listed on page 4 and the back of this brochure.

Guidelines for men, and for women not planning to become pregnant

Kind of fish you eat	How often can you eat it?*
Fish caught in Minnesota:	
Sunfish, crappie, yellow perch, bullheads	unlimited amount
Walleyes, northern pike, smallmouth bass, largemouth bass, channel catfish, flathead catfish, white sucker, drum, burbot, sauger, carp, lake trout, white bass, rock bass, whitefish, other species	1 meal a week
Commercial fish:	
Limit the following species: shark, swordfish, tile fish, king mackerel	1 meal a month

* In general, adults who eat fish just during vacation or one season can eat fish twice as often as recommended in these guidelines.

Pregnant women, women planning to become pregnant and children under age 15

If you are pregnant, planning to become pregnant, breastfeeding or have children under age 15, you and your children are more sensitive to contaminants. You need to be more careful about the kinds of fish you eat and how often you eat fish.

Fish from some Minnesota lakes and rivers have been found to have higher levels of mercury or PCBs. If you eat certain fish from these waters, you should eat it *less often* than the guidelines below. For further information on restrictions for eating fish from specific Minnesota lakes and rivers, contact the Minnesota Department of Health at the phone numbers or Web site listed on page 4 and the back of this brochure.

Guidelines for pregnant women, women planning to become pregnant and children under age 15

Kind of fish you eat	How often can you eat it?*
Fish caught in Minnesota:	
Sunfish, crappie, yellow perch, bullheads	1 meal a week
Walleyes shorter than 20 inches, northern pike shorter than 30 inches, smallmouth bass, largemouth bass, channel catfish, flathead catfish, white sucker, drum, burbot, sauger, carp, lake trout, white bass, rock bass, whitefish, other species	1 meal a month
Walleyes longer than 20 inches, northern pike longer than 30 inches, muskellunge	**Do not eat.**
Commercial fish:	
• Shark, swordfish, tile fish, king mackerel	**Do not eat.**
• Other commercial species, including canned tuna	See MDH's brochure, *"An Expectant Mother's Guide to Eating Minnesota Fish."*

* These guidelines apply even if eating fish just during a vacation or for just one season.

Questions & Answers About Fish Contaminants

Q. What are the contaminants found in fish and where do they come from?

A. In Minnesota, **mercury** is the contaminant in fish that causes the most concern. Air pollution is the major source of mercury that contaminates the fish in Minnesota's lakes and rivers. About 70 percent of the mercury in the air is the result of emissions from coal combustion, mining, incineration of mercury-containing products and other human sources. Over time, fish can accumulate relatively high mercury concentrations. That's why it's important to make wise choices about the fish you eat and how often you eat it.

There are also other contaminants in fish, including **PCBs**. PCBs are man-made substances that were banned in 1976. Levels have declined, but PCBs are still found in the environment.

Q. Which lakes and rivers have fish with contaminants?

All fish contain some mercury. It may seem surprising, but fish from lakes in the northeastern portion of Minnesota generally have higher levels of mercury. Although many of these lakes are relatively pristine, airborne contaminants still fall on them. Unfortunately, the sensitive natural water chemistry in these lakes efficiently turns non-harmful forms of mercury into a potentially harmful form. As a result, fish in these lakes accumulate more mercury.

PCBs are found mainly in Lake Superior and major rivers such as the Mississippi River.

Q. How can mercury and PCBs in fish harm me?

A. In adults, prolonged exposure to mercury can damage your kidney and nervous system. It may cause tingling, prickling or numbness in hands and feet or changes in vision. Exposure to PCBs may increase the risk of cancer.

Q. How can they harm children and babies?

A. Young children, developing fetuses and breast-fed babies are at most risk, because small amounts of mercury can damage a brain that is just starting to form or grow. Too much mercury may affect a child's behavior and lead to learning problems later in life. Babies who are exposed to PCBs during pregnancy may have lower birth weight, reduced head size and delayed physical development.

For more information, and a copy of the brochure, "*An Expectant Mother's Guide to Eating Minnesota Fish*," contact the Minnesota Department of Health at the phone numbers or Web site listed on page 4 and the back of this brochure.

Q. What can be done to reduce the amount of mercury in fish?

A. Mercury is found in many common household items, such as fever and cooking thermometers, thermostats and fluorescent lamps. One of the best ways to keep mercury out of the home and the environment is to avoid purchasing mercury-containing products and use mercury-free alternatives. When discarding products containing mercury, it is important to dispose of them properly. Using less energy and supporting alternative energy sources also reduces mercury in the environment.

Minnesota has led the nation in efforts to keep mercury out of the environment. However, more needs to be done on national and international levels, because mercury vapor is transported long distances in the atmosphere. For more information about preventing and reducing pollution, contact the Minnesota Pollution Control Agency at the phone numbers or Web site listed on the back of this brochure.

For More Information

Call or visit us on the Web:

Minnesota Department of Health
www.health.state.mn.us/divs/eh/fish/index.html
651/201-4911
1-800-657-3908
TDD: 651/201-5797

Minnesota Department of Natural Resources
www.dnr.state.mn.us
651/296-6157
1-800-MINNDNR
TTY: 651/296-5484 or 1-800-657-3929

Minnesota Pollution Control Agency
www.pca.state.mn.us (search for mercury or PCBs)
651/296-6300
1-800-657-3864

Minnesota Department of Health
121 East Seventh Place, Suite 220
P.O. Box 64975
St. Paul, MN 55164-0975

To request this document in another format, such as large print, Braille or cassette tape, call 651/201-4911 TDD 651/201-5797 or toll-free through the MN Relay Service, 1-800-627-3529.

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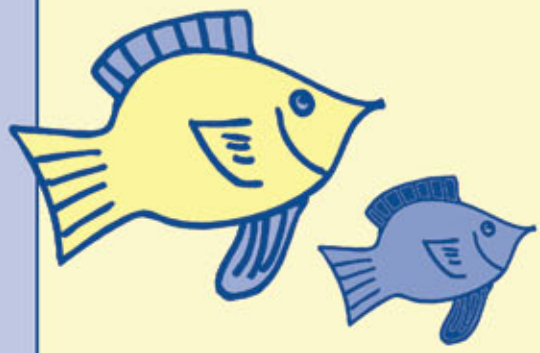
Cover: Original batik by Sue Duda, Minocqua, Wisconsin

IC #141-0378
March 2006

An Expectant Mother's Guide to Eating Minnesota Fish



What you should know if you are pregnant, planning to be pregnant or breastfeeding

MINNESOTA MDH DEPARTMENT OF HEALTH

Fish are an excellent low-fat food. Eat a variety of fish as part of your balanced food choices.

There are many reasons to enjoy a variety of fish often:

- Fish are a great source of protein, vitamins and minerals.
- The oils found in fish are important for unborn and breast-fed babies.
- Eating fish may play a role in the prevention of heart disease in adults.

However, fish may contain contaminants that could harm you or your family if you eat certain types of fish or eat fish too often.

If you are pregnant, planning to be pregnant, breastfeeding or have young children, read on to learn how to include fish as part of healthy, balanced food choices.

This brochure will help you to:

- decide *which fish* to eat
- determine *how often* to eat fish
- identify fish high in contaminants

Do you eat...

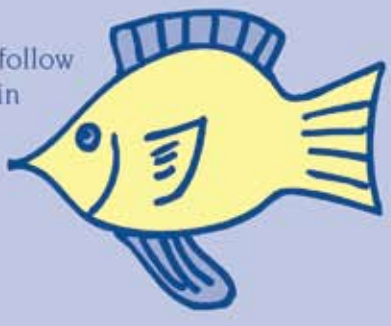
- **large walleyes, northern pike, or bass?**
- **canned "white" tuna, fresh tuna or halibut more than twice a month?**
- **swordfish or shark?**

If so, you may need to change the *kinds of fish* you eat or *how often* you eat fish.

Your body can handle some exposure to contaminants. However, a developing child or unborn baby can handle less than an adult. If you are pregnant, planning to be pregnant or breastfeeding, you need to be more careful.

Should I just stop eating fish?

NO ...
just be sure to follow the guidelines in this brochure.



This brochure was produced as a collaborative effort between the Minnesota Department of Health and dietitians from HealthPartners, Inc.

What kinds and how much fish should I eat?

The following guidelines are for women of child-bearing age and children under 15 years of age.

Follow these guidelines when eating fish:

For fish caught in Minnesota lakes and rivers:

Amount of each type of fish caught in Minnesota		
• Panfish (sunfish & crappie) • Perch • Bullheads	• Walleyes *shorter than* 20 in. • Northern pike *shorter than* 30 in. • All sizes of other species	• Walleyes *longer than* 20 in. • Northern pike *longer than* 30 in. • Muskellunge
↓ 1 meal a week	↓ 1 meal a month	↓ **Do not eat.**

These fish are more likely to contain higher amounts of contaminants:

- larger fish
- older fish
- fish that feed on other fish (walleyes, northern pike, bass)
- fatty fish

For commercial fish (bought in a store or eaten in a restaurant):

Amount of each type of fish		
• Salmon • Catfish • Shrimp • Cod • Tilapia • Crab • Pollock • Herring • Scallops • Canned "light" tuna (6 oz.) • Sardines • Oysters	• Canned "white" tuna (6 oz.) • Tuna steak • Halibut • Lobster	• Shark • Swordfish • Tile fish • King mackerel
↓ 2 meals a week	↓ 2 meals a month	↓ **Do not eat.**

Include all sources of fish you eat when making choices.

For example: If you eat one 6 oz. can of white (albacore) tuna, then wait two weeks before eating another meal of *any* type of fish. Or, if you eat one meal from an 18-inch walleye, *do not eat any other meals of fish for one month.*

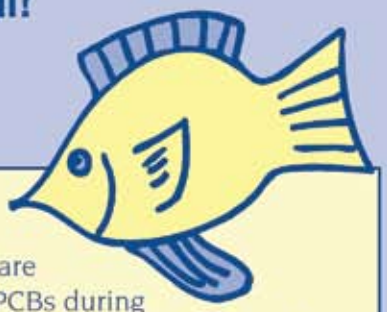
More information

These are general guidelines based on mercury levels measured in fish throughout Minnesota and levels of mercury found in commercial fish. Specific meal advice is available for eating fish from lakes and rivers that have been tested.

For information on consumption guidelines for commercial fish and for fish from specific Minnesota lakes and rivers, call 651/215-0950 or 1-800-657-3908 or visit our Web site at www.health.state.mn.us

How can contaminants in fish be harmful?

Fish advisories in Minnesota are based on levels of mercury and PCBs in the fish.



Mercury

Small amounts of mercury can damage a brain that is just starting to form or grow. That's why young children, unborn and breast-fed babies are at most risk. Too much mercury may affect a child's behavior and lead to learning problems later in life.

Mercury can also harm older children and adults, but it takes larger amounts. It may cause tingling, prickling or numbness in hands and feet or changes in vision.

PCBs

Babies who are exposed to PCBs during pregnancy may have lower birth weight, reduced head size and delayed physical development. Exposure to PCBs may also cause cancer.

By following the guidelines in this brochure, you can reduce your exposure to the contaminants in fish and help reduce your health risks.

Methods for cleaning and cooking fish:

Mercury cannot be removed through cooking or cleaning. However, by removing fat when you clean and cook fish, you *can* help to reduce the amount of other contaminants like PCBs.

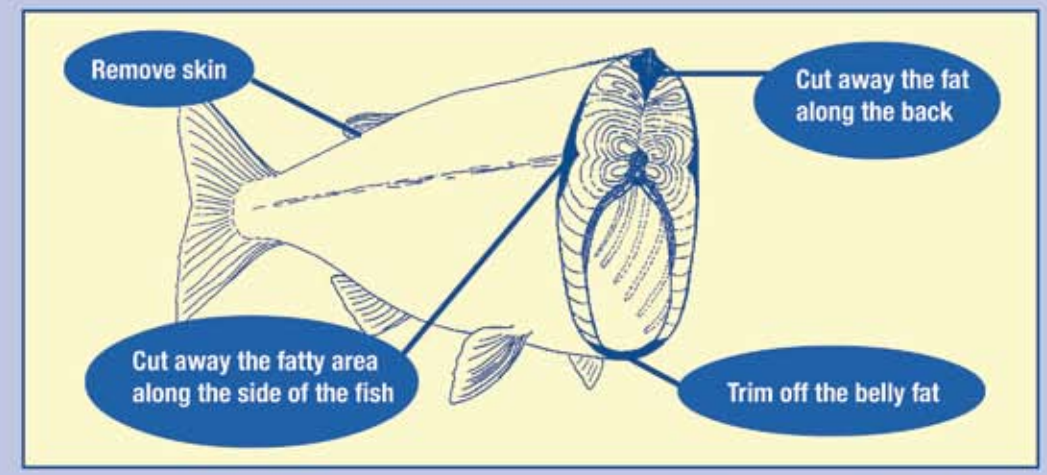


Diagram from Wisconsin Fish Advisory

Where do the contaminants in fish come from?

Mercury in Minnesota's lakes and rivers comes from air pollution. About 70 percent of the mercury in the air is the result of emissions from coal combustion, mining, incineration of mercury-containing products and other human sources. All fish have some mercury, including:

- fish caught in Minnesota lakes and rivers
- fish caught in waters in other states
- fish you buy in the store or eat in a restaurant
- fish from lakes in remote areas of northern Minnesota

PCBs are man-made substances that were once used in electrical transformers, carbonless papers, cutting oils and hydraulic fluids. PCBs were banned in 1976. Although levels have declined, PCBs are still found in the environment. They are found mainly in the Great Lakes and major rivers such as the Mississippi River.

Minnesota Department of Health
121 East Seventh Place, Suite 220
P.O. Box 64975
St. Paul, MN 55164-0975
651/215-0950 1-800-657-3908

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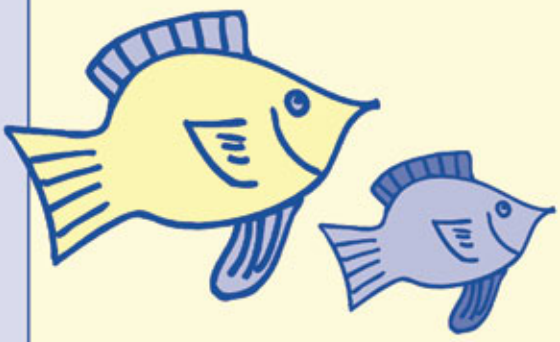
IC #141-0709
Printed on recycled paper **May 2004**

Guía sobre el consumo de pescado en Minnesota, para mujeres embarazadas



Lo que debe saber si está embarazada, tiene pensado embarazarse o amamanta

MINNESOTA MDH DEPARTMENT OF HEALTH

(Secretaría de Salud Pública de Minnesota)

El pescado es un excelente alimento bajo en grasas. Coma una variedad de pescado como parte de su dieta balanceada.

Existen muchas razones por las que debe disfrutar de una variedad de pescado a menudo:

- El pescado es una excelente fuente de proteína, vitaminas y minerales.
- Los aceites que el pescado contiene son importantes para los bebés en el seno materno y los bebés amamantados.
- El consumo de pescado puede desempeñar una función importante en la prevención de enfermedades del corazón en adultos.

Sin embargo, el pescado puede contener contaminantes que pueden ser dañinos para usted y su familia, si come ciertos tipos o los come con mucha frecuencia.

Si está embarazada, tiene pensado embarazarse, amamanta o tiene niños pequeños, lea esta información para aprender cómo incluir el pescado como parte de una dieta saludable y balanceada.

Este folleto puede ayudarle a:

- decidir *cuáles pescados* comer
- determinar la *frecuencia* con que puede comer pescado
- identificar los tipos de pescado con alto contenido de contaminantes

¿Usted come ...

- **walleye (ojizarco), northern pike (lucio del norte) o bass (róbalo) grandes?**
- **pescado más de una vez a la semana durante todo el año?**
- **más de seis onzas de atún enlatado a la semana?**
- **pez espada o tiburón?**

Si respondió afirmativamente, quizás deba cambiar los *tipos de pescado* que come o la *frecuencia* con que los come.

Su cuerpo puede tolerar una leve exposición a contaminantes. Sin embargo, los niños en desarrollo o los bebés que aún se encuentran en el seno materno toleran menos que un adulto. Si está embarazada, tiene pensado embarazarse o amamanta, debe tener más cuidado.

¿Será mejor que deje de comer pescado?

NO ...
simplemente asegúrese de seguir las directrices de este folleto.

Este folleto fue producido bajo la estrecha colaboración de la Secretaría de Salud Pública de Minnesota y los especialistas en dietética de HealthPartners, Inc.

¿Qué tipos de pescado puedo consumir y en qué cantidades?

Las siguientes directrices son para mujeres en edad de concebir y niños menores de 15 años de edad.

Siga estas directrices cuando consuma pescado :

Si el pescado proviene de lagos y ríos de Minnesota:

Cantidad de cada tipo de pescado en Minnesota		
• Panfish (pez luna y pomosio) • Perch (perca) • Bullheads (cabeza de toro)	• Walleyes (ojizarcos) de *menos* de 20 pulg. (50 cm) • Norther pike (lucio del norte) de *menos* de 30 pulg. (76 cm) • Todos los tamaños de otras especies	• Walleyes (ojizarcos) de *más* de 20 pulg. (50 cm) • Norther pike (lucio del norte) de *más* de 30 pulg. (76 cm) • Muskellunge (lucio rayado)
↓ 1 comida a la semana	↓ 1 comida al mes	↓ **No los coma.**

Estos peces tienen más probabilidades de contener mayores cantidades de contaminantes:

- **peces más grandes**
- **peces más viejos**
- **peces que se alimentan de otros peces, p. ej. walleye (ojizarco), northern pike (lucio del norte), bass (róbalo)**
- **pescados grasos**

Para el pescado comercial (obtenido en una tienda o consumido en un restaurante):

Cantidad de cada tipo de pescad				
• Salmón • Cod (bacalao) • Pollock (gado) • Atún "ligero" enlatado (6 oz.)	• Catfish (bagre) • Tilapia • Herring (arenque) • Sardinas	• Gambas • Cangrejo • Scallops (vieiras) • Ostras	• Atún "blanco" enlatado (6 oz.) • Filete de atún • Halibut (hipogloso) • Langosta	• Tiburón • Swordfish (pez espada) • Tile fish (lofolátilo) • King mackeral (caballa reina)
↓ 2 comidas a la semana			↓ 2 comidas al mes	↓ **No los coma.**

Incluya todos los tipos de pescado que come cuando haga sus elecciones.

Por ejemplo: Si come un lata de 6 oz. de atún blanco (albacora), espere dos semanas antes de preparar otra comida con *cualquier* tipo de pescado. O, si prepara una comida con un walleye (ojizarco) de 18 pulgadas, *no coma más pescado durante un mes.*

Más información

Estas son directrices generales basadas en los niveles de mercurio que los peces de Minnesota contienen y los niveles de mercurio que los peces comerciales contienen. Hay recomendaciones específicas para el consumo de pescado de los lagos y ríos que han sido analizados. También existen recomendaciones para personas que solamente comen pescado durante sus vacaciones o en una sola temporada del año.

Para obtener más información sobre las pautas de consumo de pescado comercial o de pescado procedente de determinados lagos o ríos de Minnesota, llame al 651/215-0950 o al 1-800-657-3908 o visite nuestro sitio web en www.health.state.mn.us

¿Cómo pueden hacernos daño los contaminantes que el pescado contiene?

Los informes consultivos de Minnesota sobre el consumo de pescado se basan en los niveles de mercurio y de bifenilos policlorados (PCB) en el pescado.

Mercurio

El mercurio en cantidades pequeñas puede dañar el cerebro que apenas se comienza a desarrollar. Por eso los niños pequeños, los bebés aún en el seno materno y los amamantados corren el mayor riesgo. El exceso de mercurio puede afectar el comportamiento de su niño y causar problemas del aprendizaje posteriormente.

El mercurio también puede ser dañino para niños más grandes y adultos, pero se requieren cantidades mayores. Puede causar una sensación de cosquilleo, picor, o entumecimiento en las manos y los pies, o cambios en la vista.

PCBs

Los bebés expuestos a PCB durante el embarazo suelen pesar menos al nacer, tener la cabeza más pequeña y retrasarse en su desarrollo físico. La exposición a PCB también puede causar cáncer.

Si sigue las directrices recomendadas en este folleto puede reducir su exposición a los químicos que se encuentran en el pescado y ayudar a reducir los riesgos para su salud.

Métodos para limpiar y cocinar pescado:

Cocinar y limpiar el pescado no elimina el mercurio. Sin embargo, si elimina la grasa cuando limpia y cocina el pescado, *puede* ayudar a reducir la cantidad de contaminantes, tales como los PCBs.

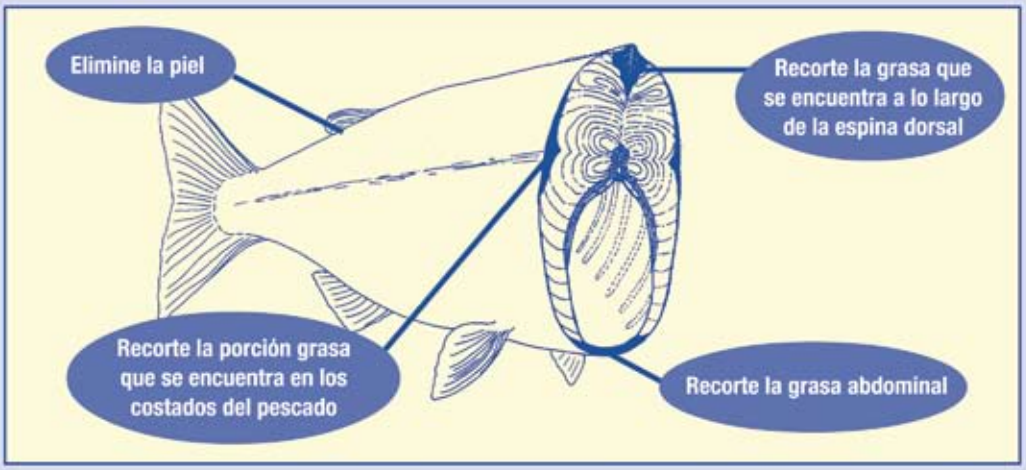


Diagrama obtenido del informe consultivo del pescado de Wisconsin

¿De dónde provienen los contaminantes del pescado?

El **mercurio** de los lagos y ríos de Minnesota procede de la contaminación del aire. Cerca del 70 por ciento del mercurio que hay en el aire procede de emisiones por la combustión y extracción de carbón, la combustión de productos que contienen mercurio y otras fuentes causadas por el hombre. Todos los peces tienen algo de mercurio, incluidos los siguientes:

- los pescados en los lagos y ríos de Minnesota:
- los pescados en las aguas de otros estados
- el pescado comprado en tiendas o consumido en restaurantes
- el pescado de los lagos de lugares remotos del norte de Minnesota

PCBs. Estas son sustancias elaboradas por el ser humano, las cuales se utilizaban en transformadores eléctricos, papel autocopiante, aceite de corte y líquidos hidráulicos. El uso de los PCB está prohibido desde 1976. Aunque los niveles han disminuido, aún existen PCBs en el ambiente. Se encuentran principalmente en los Grandes Lagos y en ríos de gran caudal, como el Mississippi.

Minnesota Department of Health
(Secretaría de Salud Pública de Minnesota)
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P.O. Box 64975
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Impreso en papel reciclado
IC #141-0059
Mayo de 2004

MINNESOTA MDH DEPARTMENT OF HEALTH

March 2006

Fish Consumption Advisory Materials

Please indicate the number of copies you want next to the items listed, below.

Brochures

_____ **Eat Fish Often? A Minnesota Guide to Eating Fish** Our new annual advisory brochure. Contains health-based advice on eating fish from lakes and rivers in Minnesota. March 2006 (IC# 141-0378)

_____ **An Expectant Mother's Guide to Eating Minnesota Fish** What you should know if you are pregnant, planning a pregnancy, or nursing a baby. For use in clinical or childbirth education, and by consumers. March 2006. (IC# 141-0709)

_____ **Spanish Version of An Expectant Mother's Guide to Eating Minnesota Fish** March 2006 (IC# 141-0059)

Magnet

_____ 2x4 magnet. "Eat smaller fish, they taste better and have fewer pollutants" (IC# 399-0406)

Limit of 300 per organization

Please print or type the **street address** for delivery of your order.

Name_____

Organization_____

Street Address_____

City_____ State_____ Zipcode_____

Telephone # _____

Fax this form to MDH at (651) 201-4606; or **mail** it to us at:

Fish Consumption Advisory
Minnesota Department of Health
P.O. Box 64975
St. Paul, MN 55164-0975

Questions?
Contact the Minnesota Fish Consumption Advisory program at (651) 201-4911, or, in Greater Minnesota, 1-800/657-3908, and press 1. To request this document in another format, call (651) 201-5000, TDD (651) 201-5797. Permission is given to photocopy the materials listed on this form.

Appendix I:
NYSDOH Outreach Materials

Eating Sport Fish

2005-2006 Health Advice for
the Capital District, Hudson River,
New York Harbor, Fresh Waters of Long Island and
Marine Waters of New York

Fishing New York's abundant waters is a popular sport. Anglers catch a wide variety of delicious fish and many eat the fish they catch. However, some species in certain waters contain chemicals that may be harmful to health, even when the fish look healthy and the water looks clean. What should you consider when deciding whether or not to eat the fish you catch? The New York State Department of Health issues health advisories for people who eat fish from waters where chemical contaminants may be a problem. You can make an informed decision about the potential risks from eating contaminated sport fish by using this publication. More detailed advice can be found in the *New York State Fishing Regulations Guide* (available where fishing licenses are sold) or in a booklet which can be requested from the Department of Health at 1-800-458-1158, ext. 27815.

Why Is This Advice Important to Me?

Chemicals are found in some fish at levels that may be harmful to your health. Some chemicals build up in your body over time or effect organs, such as your kidneys or liver.

Women of childbearing age may be at special risk from eating contaminated fish. During pregnancy and when breast-feeding, some chemicals (such as PCBs, dioxins and mercury) may be passed on to your baby. This can harm the baby's growth and development. **Children** under the age of 15 should not eat contaminated fish because they are still growing and developing, and are at special risk from contaminants.

How Much Fish Can I Eat?

Generally, no one should eat no more than one meal of fish per week from any of the state's fresh waters. Some waters in New York have even stricter health advisories.

The following guidelines are a shortened version of the complete health advisories for the Capital District, Hudson River, New York Harbor, the fresh waters of Long Island and marine waters of New York State. For more detailed advice about eating fish, please consult *Health Advisories: Chemicals in Sport Fish and Game* available from the Health Department by calling 1-800-458-1158, ext. 27815.

Which Fish are Safer (Less Contaminated) to Eat?

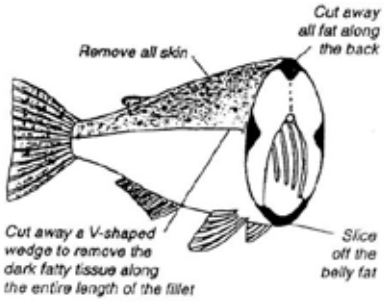
You can limit your exposure to chemical contaminants in these ways:

- Choose fish not mentioned in the advisories--those fish generally have lower contaminant levels.
- Choose smaller fish (of legal size) to eat. Smaller fish are younger and generally have lower contaminant levels than larger, older fish.
- Fish from Long Island South Shore waters and eastern Long Island Sound waters generally have lower contaminant levels than fish from the Hudson River and the Upper Bay of New York Harbor.
- See other side for more restrictive health advisories.

Can I Clean and Cook My Fish to Reduce Contaminants?

You can reduce your exposure to chemical contaminants by the way you prepare the fish. Many chemicals concentrate in the fatty parts of fish. By cleaning or cooking fish to reduce fat, you can also reduce the amount of contaminants you eat.

- Remove the skin and trim all fat from the areas shown below.
- Don't pan-fry or deep-fry. Broil, bake, poach or boil your fish so the fatty juices drip away.
- Don't consume cooking liquids.



Catch and Release

Anglers who want to continue to enjoy the fun of fishing, but who also wish to lessen the potential risks associated with eating contaminated sport fish, should consider catch and release. Catch and release also minimizes your impact on local fisheries. When practicing catch and release, follow these simple guidelines:

- Release fish quickly--while still in the water, if possible; have necessary tools (needlenose pliers) close at hand.
- When a fish is deeply hooked, do not tear out the hook--cut the leader or the hook to give the fish a nearly fourfold increase in chances of survival.
- Avoid playing fish to exhaustion, particularly if water temperatures are very high.

For more detailed information about catch and release, consult the *New York State Fishing Regulations Guide* available wherever fishing licenses are sold.

Prepared by:
New York State Department of Environmental Conservation
and the New York State Department of Health

Hudson River between Bakers Falls (in Hudson Falls) and the Federal Dam at Troy:

- Catch and release fishing only--these regulations apply to the portion of the Hudson River noted above and all tributaries upstream to the first barrier impassable by fish. All fish caught must be immediately returned to the water unharmed.

General Health Advisory

For the waters listed below, the general health advice recommendation is:

- Women of childbearing age and children under 15 should EAT NO FISH from the waters listed below.
- Other people should follow the recommendations provided for each water listed below and should eat no more than one meal per week of any fish species not listed.

Hoosic River
- Eat no more than one meal per month of brown trout over 14 inches long.

Kinderhook Lake
- Eat no more than one meal per month of American eel.

Nassau Lake
- Eat no fish.

Valatie Kill between County Route 18 and Nassau Lake
- Eat no fish.

Hudson River and All Tributaries to the First Barrier Impassable by Fish:

Corinth Dam downstream to Dam at Route 9 Bridge in South Glens Falls
- Eat no more than one meal per month of smallmouth bass over 14 inches long.

Sherman Island Dam downstream to feeder dam at South Glens Falls
- Eat no more than one meal per month of carp.

Dam at Route 9 Bridge in South Glens Falls to Federal Dam at Troy
- Eat no fish.

Federal Dam at Troy south to bridge at Catskill
- Eat no fish except alewife, American shad, blueback herring, rock bass and yellow perch.
- Eat no more than one meal per month of alewife, blueback herring, rock bass and yellow perch.
- Eat no more than one meal per week of American shad (general advisory)

Hudson River South of Catskill, Arthur Kill, Kill Van Kull and Upper Bay of New York Harbor (North of Verrazano Narrows Bridge)
- Eat no gizzard shad.
- Eat no more than one meal per month of American eel, Atlantic needlefish, bluefish, brown bullhead, carp, channel catfish, goldfish, largemouth and smallmouth bass, rainbow smelt, striped bass, walleye, white catfish and white perch and eat no more than one meal per week of other fish species.
- Eat no more than six blue crabs per week and don't consume the hepatopancreas (mustard, tomalley, liver) or cooking liquid.

Hudson River - Dobbs Ferry south to Greystone
- Eat no American eel
- Follow advisories for Hudson River south of Catskill for other species.

Harlem River and East River (to the Throgs Neck Bridge)
- Eat no American eel
- Eat no more than one meal per month of Atlantic needlefish, bluefish, striped bass and white perch.

Boyds Corner Reservoir (Putnam Co.)
- Eat no more than one meal per month of largemouth bass over 16 inches and walleye.

Diverting, East Branch and West Branch Reservoirs (Putnam Co.)
- Eat no more than one meal per month of walleye.

Bog Brook Reservoir (Putnam Co.)
- Eat no more than one meal per month of walleye over 21 inches

Amawalk and Cross River Reservoirs (Westchester Co.)
- Eat no more than one meal per month of largemouth and smallmouth bass over 16 inches.

Sawmill River (Westchester Co.)
- Eat no more than one meal per month of American eel.

Sheldrake River (Westchester Co.)
- Eat no American eel
- Eat no more than one meal per month of goldfish.

Titicus Reservoir (Westchester Co.)
- Eat no more than one meal per month of white perch.

Inland Waters of Long Island

Freeport Reservoir and Grant Park Pond (Nassau Co.)
- Eat no more than one meal per month of carp.

Lake Capri (Suffolk Co.)
- Eat no more than one meal per month of American eel or carp.

Hall's Pond (Nassau Co.) and Spring Pond-Middle Island (Suffolk Co.)
- Eat no carp or goldfish

Loft's and Whitney Park Ponds (Nassau Co.)
- Eat no more than one meal per month of carp or goldfish.

Ridder's Pond (Nassau Co.)
- Eat no goldfish.

St. James Pond (Suffolk Co.)
- Eat no more than one meal per month of all species.

Smith Pond at Roosevelt Park (Nassau Co.)
- Eat no American eel.
- Eat no more than one meal per month of carp and goldfish.

Smith Pond at Rockville Center and Upper Massapequa Reservoir (Nassau Co.)
- Eat no more than one meal per month of white perch.

Upper Twin Pond (Nassau Co.)

Eat no more than one meal per month of American eel

Marine Waters:

Lower Bay of New York Harbor, Jamaica Bay, Long Island Sound, Peconic and Gardiners bays, Block Island Sound and Long Island South Shore Waters
- The general health advisory does not apply to these waters. However, some species of fish and shellfish do contain chemical contaminants at levels that may cause adverse human health effects. For those species, people should follow the advice given below.
- Women of childbearing age and children under the age of 15 should eat no striped bass from New York Harbor and Long Island Sound west of Wading River. Other people should eat no more than one meal per month of striped bass from these waters.
- Everyone should eat no more than one meal per week of striped bass from Long Island Sound east of Wading River, Peconic and Gardiners Bays, Block Island Sound, Long Island South Shore waters and Jamaica Bay.
- Everyone should eat no more than one meal per week of American eel and bluefish from any of these waters.
- Do not eat the hepatopancreas (mustard, tomalley, liver) of American lobster and blue crab. Discard all cooking liquids.

This summary is only a quick reference. For more complete information, consult *Health Advisories: Chemicals in Sport Fish and Game* published annually by the New York State Department of Health. This publication provides advisories on eating fish from all New York waters, describes the contaminants and reasons for the advisories and tells how to space meals so exposure to chemicals is not excessive. If you eat fish from other New York State waters, call the Department of Health toll-free at 1-800-458-1158, ext. 27815 for a free copy of the advisory or to speak with someone about any questions you may have. The full advisories are also available on the internet: http://www.nyhealth.gov/nysdoh/fish/fish.htm or can be requested by e-mail: *BTSA@health.state.ny.us*

Consumo de la Pesca Deportiva

Recomendaciones de Salud para 2002-2003 para el Distrito de la Capital, el Río Hudson, el Puerto de Nueva York, los Cuerpos de Agua Dulce de Long Island y las Aguas Marinas de Nueva York

En las aguas abundantes de Nueva York, la pesca deportiva es un deporte popular. Los pescadores de anzuelo pescan una gran variedad de peces deliciosos y muchos comen los pescados. Sin embargo, algunas especies en ciertas aguas contienen químicos que pueden ser dañinos para la salud, aún cuando los peces luzcan saludables y las aguas parescan limpias.

¿Qué debe de tomar en cuenta antes de decidir si debe comer o no comer los pescados que ha pescado? El Departamento de Salud del Estado de Nueva York publica recomendaciones de salud para personas que comen pescados de aguas donde las contaminaciones químicas pueden ser un problema. Usando esta publicación, usted puede hacer una decisión acertada sobre los riesgos potenciales al consumir la pesca deportiva contaminada. Información más detallada puede ser hallada en la guía *New York State Fishing Regulations Guide o La Guía de Reglamentos de Pesca del Estado de Nueva York* (publicado en Inglés y disponible donde se venden las licencias para la pesca) o en un folleto que puede ser solicitado al Departamento de Salud llamando al 1-800-458-1158, extensión 27815.

¿Por qué es importante este consejo para mí?

En algunos peces se encuentran productos químicos a un nivel que puede ser dañino para su salud. Algunos químicos se acumulan en su cuerpo a través del tiempo y/o afectan sus órganos tales como los riñones o el hígado.

Las mujeres que están en edad de procrear hijos pueden tener un riesgo especial al comer pescado contaminado. Durante el embarazo y cuando amamanta al bebé, algunos químicos (tales como la dioxina, el mercurio y los PCB tambien conocidos como bifenales policlorinados o BPC) pueden ser transmitidos al bebé. Esto puede perjudicar el crecimiento y el desarrollo del mismo. **Los niños menores de 15 años de edad** no deben comer pescado contaminado porque ellos todavía se están desarrollando y creciendo y están expuestos a un riesgo especial a consecuencia de los contaminantes.

¿Qué cantidad de pescado puedo comer?

Generalmente, nadie debe comer pescado de las aguas dulces del estado más de una vez por semana. Sin embargo, algunas extensiones de agua en Nueva York tienen recomendaciones de salud aún más estrictas.
La siguiente información es una versión abreviada de las recomendaciones de salud para el Distrito de la Capital, el Río Hudson, el Puerto de Nueva York, las extensiones de agua dulce de Long Island y las aguas marinas de Nueva York. Para obtener información más detallada sobre el consumo de pescado, favor de consultar a *Health Advisories: Chemicals in Sport Fish and Game (Recomendaciones de Salud: Químicos en la Pesca Deportiva y la Caza)*, disponible por medio del Departamento de Salud llamando al 1-800-458-1158, extensión 27815.

¿Cuáles son los pescados más sanos (menos contaminados) para comer?

Usted puede limitar su exposición a los contaminantes químicos de las siguientes maneras:

- Eligiendo comer pescados que no se mencionen en los consejos de salud—los pescados no mencionados generalmente tiene menores niveles de contaminación.
- Eligiendo comer pescados pequeños (de tamaño legal). Los peces pequeños son más jovenes y por lo general contienen menos contaminación que los peces más grandes y más viejos.
- Los peces de las aguas de la Orilla Sur de Long Island y de la zona este del Estrecho de Long Island generalmente tiene niveles de contaminantes más bajos que los pescados del Río Hudson y de la Bahía Superior del Puerto de Nueva York.
- Vea al dorso para recomendaciones más restringuidas.

¿Puedo limpiar y cocinar mi pescado para reducir los contaminantes?

Usted puede reducir su exposición a los contaminantes químicos según la manera en que prepara el pescado. Muchos contaminantes químicos se concentran en las partes grasosas del pescado. Al limpiar y cocinar el pescado en forma que reduzca la grasa, usted puede reducir la cantidad de contaminantes que ingiere.

- Quite la piel y corte toda la grasa de las áreas señaladas en el dibujo.
- No fría el pescado en el sartén ni por inmersión en aceite. Cocínelo a la parilla, al horno, o hiérvalo para escurrir los jugos grasosos.
- No coma los líquidos donde cocine el pescado.

Pesca y Suelta

Los pescadores que desean continuar disfrutando del placer de la pesca deportiva, pero también quieren disminuir el riesgo potencial asociado con el consumo de pescado contaminado, deben considerar la práctica de la pesca y suelta, la cuál a la vez reduce a un mínimo su impacto en la población de peces. Cuando practique la pesca y suelta, tome las siguientes medidas para soltar:

- Libere el pez rápidamente, si es posible, cuando aún esté en el agua; tenga a mano las herramientas necesarias (alicate de punta fina).
- Si el pez está bien enganchado al anzuelo, no jale el anzuelo—corte la parte más fina del sedal o del anzuelo para darle al pez una oportunidad cuádruple de sobrevivir.
- Evite jugar con el pez hasta el punto de agotarlo, especialmente si la temperatura del agua está muy alta.

Para información más detallada sobre la pesca y suelta, consulte a la guía *New York State Fishing Regulations Guide o La Guía de Reglamentos de Pesca del Estado de Nueva York* (publicado en Inglés), disponible en las oficinas del Departamento de Conservación Ambiental o dondequiera que se venda las licencias de pesca.

Preparado por:
El Departamento de Conservación Ambiental del Estado de Nueva York
y
El Departamento de Salud del Estado de Nueva York

Río Hudson

El Río Hudson de las Cataratas Bakers (en Hudson Falls) hasta la Represa Federal en Troy:

- Pesca y suelta solamente—este reglamento aplica a la parte del Río Hudson anotada anteriormente y a todos los tributarios río arriba hasta la primera barrera impasable por los peces. Todos los peces pescados deben ser regresados al agua de inmediato sin ser lastimados.

*Aviso General Para la Salud

Para las siguientes extensiones de agua, las recomendaciones generales para la salud son:

- Las mujeres que están en edad de procrear hijos y los niños menores de 15 años de edad NO DEBEN COMER PESCADOS de las extensiones de agua mencionadas a continuación.
- Las demás personas deben seguir las recomendaciones provistas para cada extensión de agua mencionada y no deben comer más que una comida (1/2 libra de pescado) por semana de cualquiera especie de pescado que no aparece en la lista.

Río Hoosic

- No coma más de una comida al mes de trucha marrón de mas de 14 pulgadas (35 centimetros).

Lago Kinderhook

- No coma más de una comida al mes de anguila americana.

Lago Nassau

- No coma ningún pescado.

Valatie Kill entre ruta 18 del condado y el Lago Nassau

- No coma ningún pescado.

Río Hudson y todos sus tributarios hasta la primera barrera impasable por los peces:

Represa Corinth hasta la Represa próxima al puente en la Route 9 en South Glens Falls

- No coma más de una comida al mes de róbalo de boca pequeña de mas de 14 pulgadas (35 centimetros).

Represa de la Isla de Sherman río abajo hasta la represa afluente en Glens Falls Sur

- No coma más de una comida al mes de carpa.

Represa próxima al puente en la Route 9 en South Glens Falls hasta la Represa Federal de Troy

- No coma ningún pescado..

Al sur de la Represa de Troy hasta el puente de Catskill

- No coma pescado a menos que sea sábalo americano, pinchaqua, arenque de espalda azul, robalo de risco o percha amarilla.
- No coma mas de una comida al mes de pinchaqua, arenque de espalda azul, robalo de risco o percha amarilla.
- No coma mas de una comida a la semana de sábalo americano (aviso general).

El Río Hudson al sur de Catskill, Arthur Kill, Kill Van Kull, y la Bahía Superior del Puerto de Nueva York (al norte del Puente Verrazano Narrows)

- No coma gizzard shad.
- No coma más de una comida al mes de anguila americana, pez aguja del atlántico, pez azulado, carpa, carpa dorada, róbalo de boca grande, róbalo de boca pequeña, eperlano arcoiris, róbalo rayado, pez de ojos albinos, siluro (bagre) blanco, channel catfish o percha blanca, y no debe comer más de una comida por semana de otras especies de pescado.
- No coma más de seis cangrejos azules por semana y no consuma ningun hepatopáncreas (la parte amarilla o anaranjada que a veces le dicen "mostaza" o hígado) o los líquidos donde cocine los cangrejos.

Al Sur de Dobbs Ferry hasta Greystone

- No coma anguila americana.
- Obedezca los avisos para el Rio Hudson al Sur de Catskill para las otras especies.

Boyd Corners Reservoir (Condado de Putnam)

- No coma más de una comida al mes de róbalo de boca grande de mas de 16 pulgadas (41 centimetros) o pez de ojos albinos.

Cross River Reservoir (Condado de Westchester)

- No coma más de una comida al mes de róbalo de boca grande o róbalo de boca pequeña de mas de 16 pulgadas (41 centimetros)

Río Sawmill (Condado de Westchester)

- No coma más de una comida al mes de anguila americana.

Río Sheldrake (Condado de Westchester)

- No coma anguila americana
- No coma más de una comida al mes de carpa dorada.

Río Harlem y Río Este (hasta el Puente de Throgs Neck)

- No coma anguila americana.
- No coma más de una comida al mes de pez aguja del atlántico, pez azulado, róbalo rayado o percha blanca

Aguas Dulces del Interior de Long Island

Embalse Freeport, Charca Grant Park (Condado de Nassau) y Lago Belmont (Condado de Suffolk)

- No coma más de una comida al mes de carpa.

Lago Capri (Condado de Suffolk)

- No coma más de una comida al mes de anguila americana o carpa.

Charca de Hall (Condado de Nassau) y Charca Spring-Middle Island (Condado de Suffolk)

- No coma carpa ni carpa dorada.

Charcas Loft y Whitney Park (Condado de Nassau)

- No coma más de una comida al mes de carpa o carpa dorada.

Charca Ridder (Condado de Nassau)

- No coma carpa dorada.

Charca St. James (Condado de Suffolk)

- No coma más de una comida al mes de todas las especies de pescado.

Charca Smith-Parque Roosevelt (Condado de Nassau)

- No coma anguila americana.
- No coma más de una comida al mes de carpa o de carpa dorada.

Charca Smith en Centro Rockville y Embalse Superior de Massapequa (Condado de Nassau)

- No coma más de una comida al mes de percha blanca.

Aguas Marinas

La Bahía Inferior del Puerto de Nueva York, la Bahía de Jamaica, el Estrecho de Long Island, las Bahías de Peconic y Gardiners, el Estrecho de Block Island, y las aguas de la Costa Sur de Long Island

Las recomendaciones generales para la salud no aplican a estas extensiones de agua. Sin embargo, algunas especies de peces y mariscos estan contaminados con sustancias químicas a niveles que pueden ser dañinos para la salud humana. Para esas especies, las personas deben seguir los siguientes consejos:

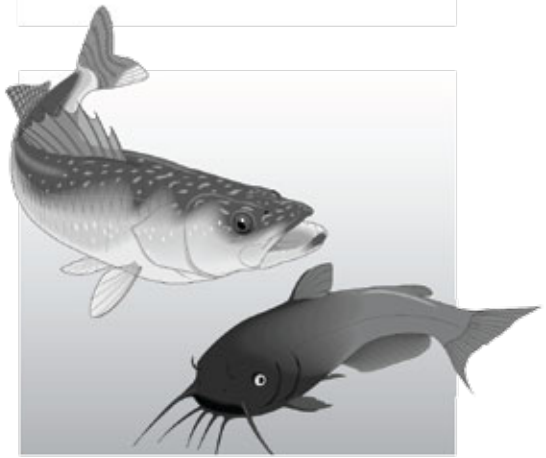
- Las mujeres que están en edad de procrear hijos y los niños menores de 15 años de edad no deben comer róbalo rayado de las aguas del Puerto de Nueva York o del Estrecho de Long Island al oeste del Río Wading. Otras personas no deben comer más de una comida al mes de róbalo rayado pescado en estas aguas.
- Nadie debe comer más de una comida por semana de róbalo rayado del Estrecho de Long Island pescado al este del Río Wading, de las Bahías de Peconic o Gardiners, del Estrecho de Block Island, de las aguas de la Costa Sur de Long Island o de la Bahía de Jamaica.
- No coma más de una comida por semana de anguila americana o pez azulado que provenga de estas aguas.
- No coma los hepatopáncreas de la langosta americana o del cangrejo azul. Deseche todos los líquidos donde los cocine.

Para más información

Para información más completa y recomendaciones para todo el estado, consulte a *Health Advisories: Chemicals in Sport Fish and Game (Recomendaciones de Salud: Químicos en la Pesca Deportiva y la Caza)*, publicado in Inglés anualmente por el Departmento de Salud del Estado de Nueva York. Llame gratis al Departamento de Salud al 1-800-458-1158, extensión 27815, para recibir una copia gratuita de las recomendaciones o para hablar con alguien sobre cualquier duda que tenga. El texto completo de las recomendaciones también se encuentra (en Ingles solamente) en el Internet: *http://www.health.state.ny.us/nysdoh/environ/fish.htm* o se puede pedir por correo electrónico (e-mail): *BTSA@health.state.ny.us*.

Potential Health Effects from Methylmercury Exposure

Most of the mercury in the edible flesh of fish is in the form of methylmercury. Most of our knowledge of health effects of methylmercury comes from high dose animal studies and human poisonings. People who ate fish and grain that contained large amounts of methylmercury had permanent damage to the nervous system, kidneys and fetus. Exposure to lower levels of methylmercury for long periods of time may increase the risk of adverse effects in humans. Exposure to methylmercury is more of a concern for unborn babies and infants who can be exposed to the methylmercury from their mother's bloodstream during pregnancy and in her breastmilk after birth.



How to Get More Information

For more complete information about the fish advisories, consult *Health Advisories: Chemicals in Sport Fish and Game* published annually by the New York State Department of Health. This publication provides advisories on eating fish from all New York State waters, specific advice on eating fish (from more than 70 waterbodies) with elevated levels of various contaminants, and information on the contaminants. It also explains how to reduce your exposures to these contaminants. For a free copy of this booklet, or if you have any questions call 1-800-458-1158, ext. 27815 (toll-free). Calls are taken from 8:00AM-4:30 PM, Monday through Friday. After hours leave a voice mail message. You may also access the full advisories on the Internet: *http://www.health.state.ny.us/nysdoh/environ/fish.htm* or request the advisories by e-mail: *BTSA@health.state.ny.us.*

If you need more information about the New York City reservoir system, including fishing access, call the New York City Department of Environmental Protection at 718-337-4357 (718-DEP-HELP) or visit DEP on-line at *http://www.ci.nyc.ny.us/dep.*

State of New York
George E. Pataki, Governor

Department of Health
Antonia C. Novello, M.D., M.P.H., Dr.P.H., Commissioner

6/02

2002

Health Advisories on Eating Sportfish

New York City Reservoir System

Revised 6/02

General Advice

Fish are good to eat and nutritious. When properly prepared, fish provide a diet high in protein and low in saturated fats. The New York State Department of Health (DOH) issues advisories on eating sportfish because some fish contain chemicals at levels that may be harmful to health. You can benefit from eating the fish you catch and minimize your exposure to chemical contaminants by following the DOH advisories.

The general health advisory for sportfish is that you eat no more than one meal (1/2 pound) per week of fish taken from any of the state's freshwaters (including the New York City reservoir system) and some marine waters at the mouth of the Hudson River.

Specific Advisories for Ashokan, Boyd Corners, Cannonsville, Cross River, Neversink, Pepacton, Rondout and Schoharie Reservoirs

When fish have contaminant levels greater than federal marketplace standards, DOH issues an advisory for that waterbody. Because of elevated mercury levels in fish collected by the New York State Department of Environmental Conservation and the New York City Department of Environmental Protection, DOH has issued specific consumption advisories for the reservoirs listed below. Based on these data, **women of childbearing age and children under the age of 15** are advised to EAT NO fish from the reservoirs listed below. Advice for other people is:

Ashokan Reservoir -
EAT NO MORE THAN ONE MEAL PER MONTH of smallmouth bass over 16 inches and walleye (all sizes)

Boyds Corner Reservoir -
EAT NO MORE THAN ONE MEAL PER MONTH of largemouth bass over 16 inches and walleye (all sizes)

Cannonsville Reservoir -
EAT NO MORE THAN ONE MEAL PER MONTH of smallmouth bass over 15 inches

Cross River Reservoir -
EAT NO MORE THAN ONE MEAL PER MONTH of largemouth bass over 16 inches and smallmouth bass over 16 inches

Neversink Reservoir -
EAT NO MORE THAN ONE MEAL PER MONTH of smallmouth bass (all sizes)

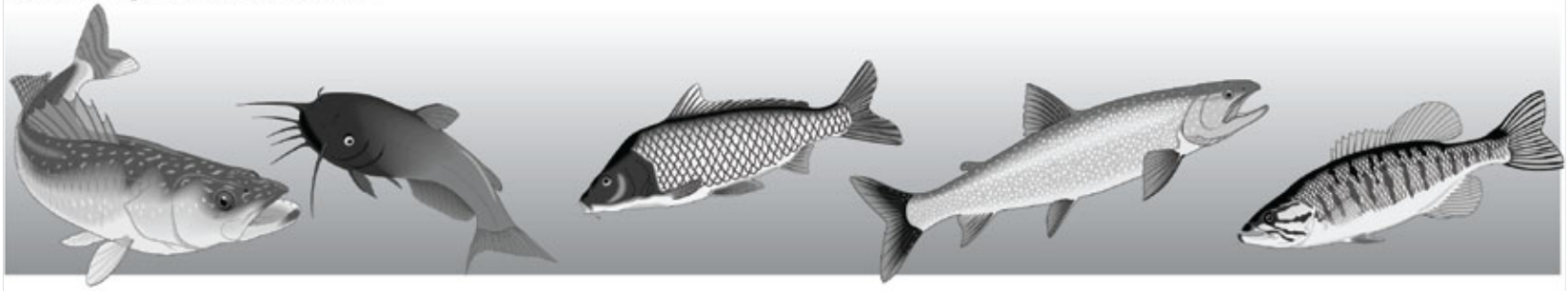
Pepacton Reservoir -
EAT NO MORE THAN ONE MEAL PER MONTH of smallmouth bass over 15 inches

Rondout Reservoir -
EAT NO MORE THAN ONE MEAL PER MONTH of smallmouth bass over 16 inches

Schoharie Reservoir -
EAT NO MORE THAN ONE MEAL PER MONTH of walleye (all sizes)

Mercury can enter water bodies from a variety of sources, including runoff from the land and deposition from the air. The specific source of mercury in each of these reservoirs has not been determined. Accumulation of mercury in fish depends on complex physical, chemical and biological factors that are not fully understood by scientists. Fish accumulate mercury from the food they eat and directly from the water. As a result, mercury concentrations are typically much higher in fish than in the water in which they live. In addition to these New York City reservoirs, elevated levels of mercury in fish have been documented in remote areas of the state such as the Adirondacks, as well as in developed areas.

New York City's water distribution system is regularly tested by the New York City Department of Environmental Protection for various contaminants, including mercury. The New York City Department of Environmental Protection's most recent annual water quality statement lists mercury among the regulated conventional physical and chemical parameters that are not detected in the City's water distribution system.



Appendix J:
GLIFWC Outreach Materials

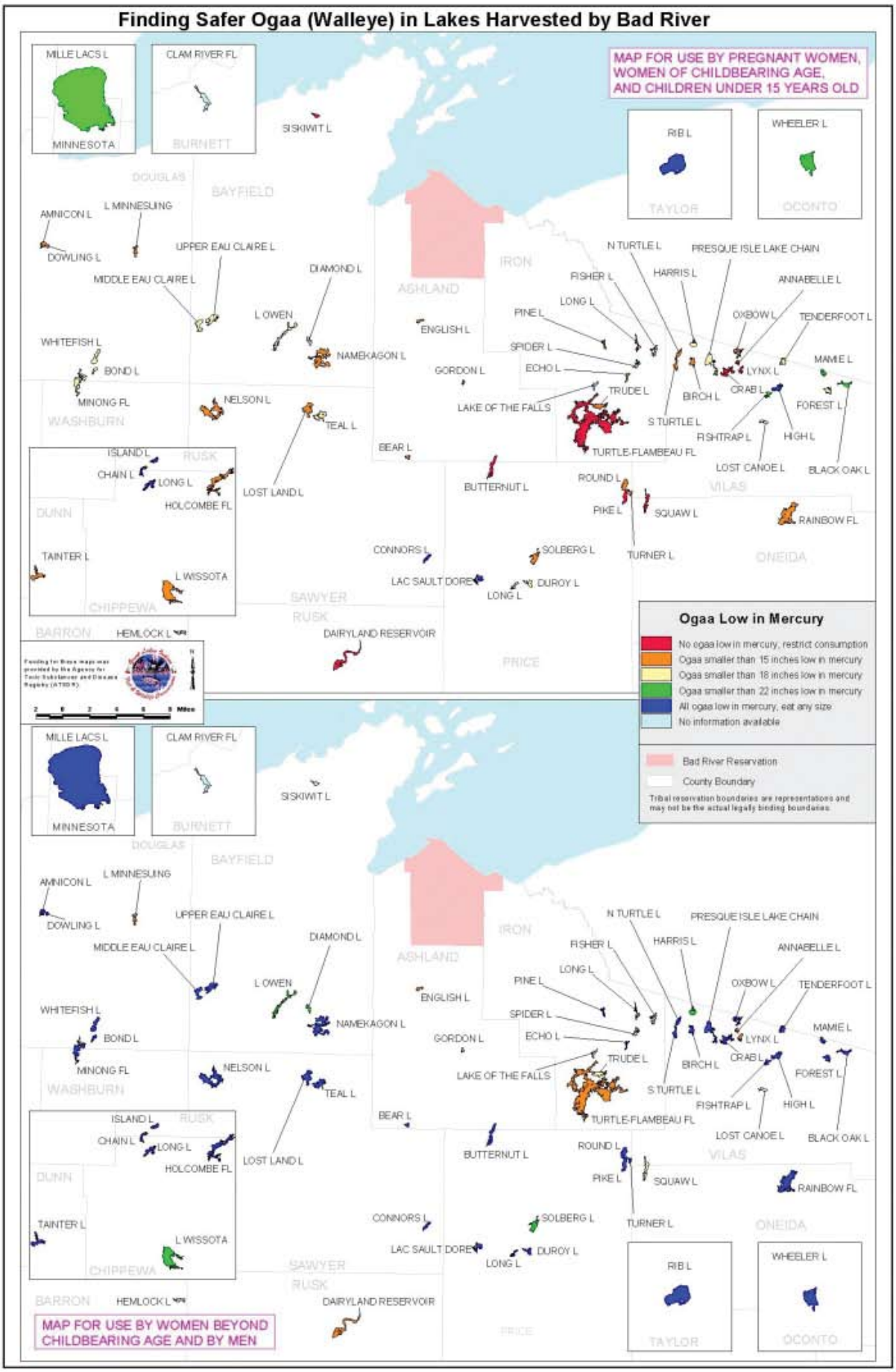
The maps on the following pages are reprinted with the permission of GLIFWC.

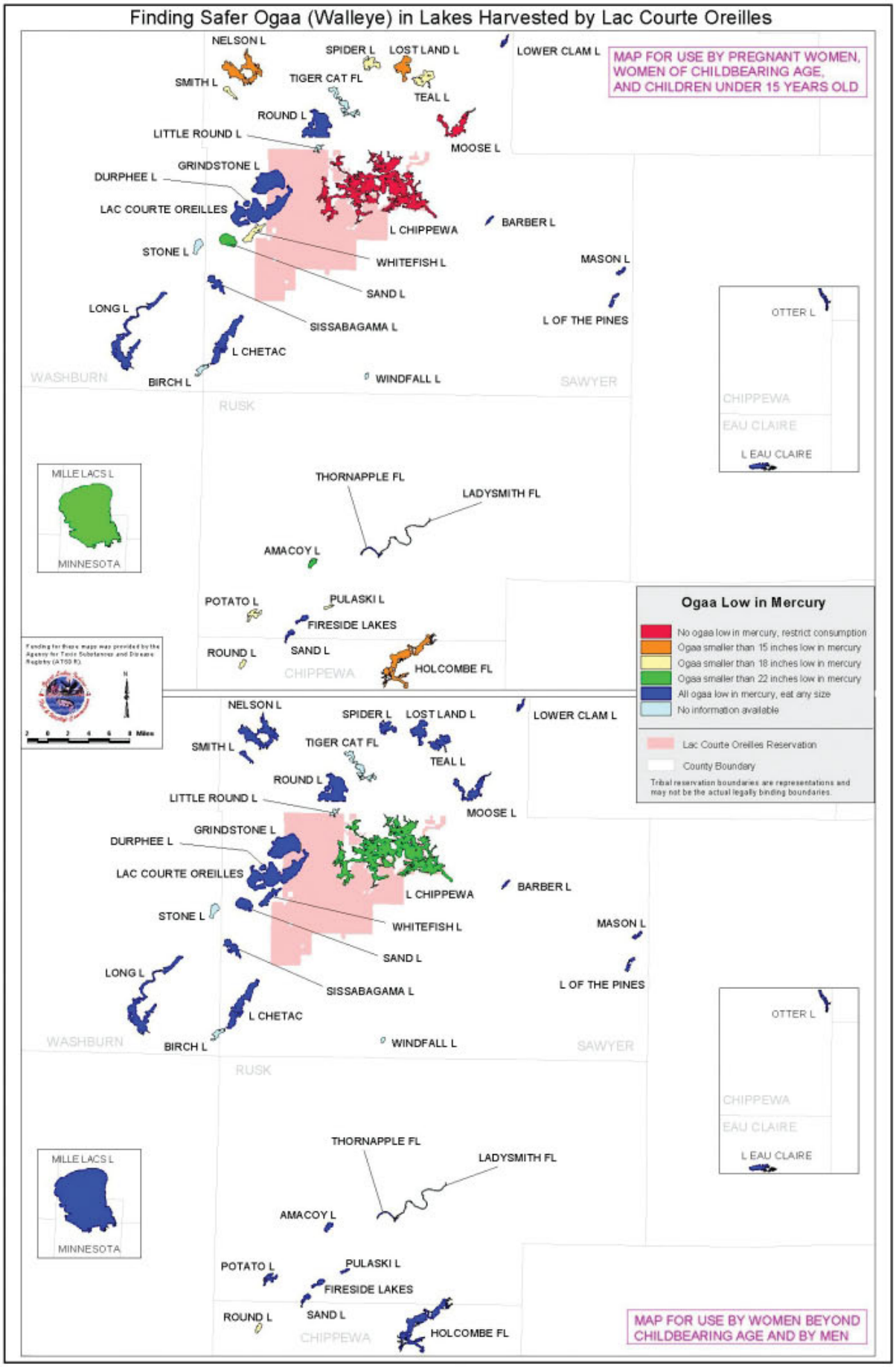
For many native people *giigoonh* (fish) are part of a traditional diet and, as such, provide health benefits. So if you rely on *giigoonh* as part of your normal diet, try to achieve a balance. Continue to eat the same amount of *giigoonh* but reduce the amount of mercury you or your family become exposed to by choosing safer *giigoonh*.

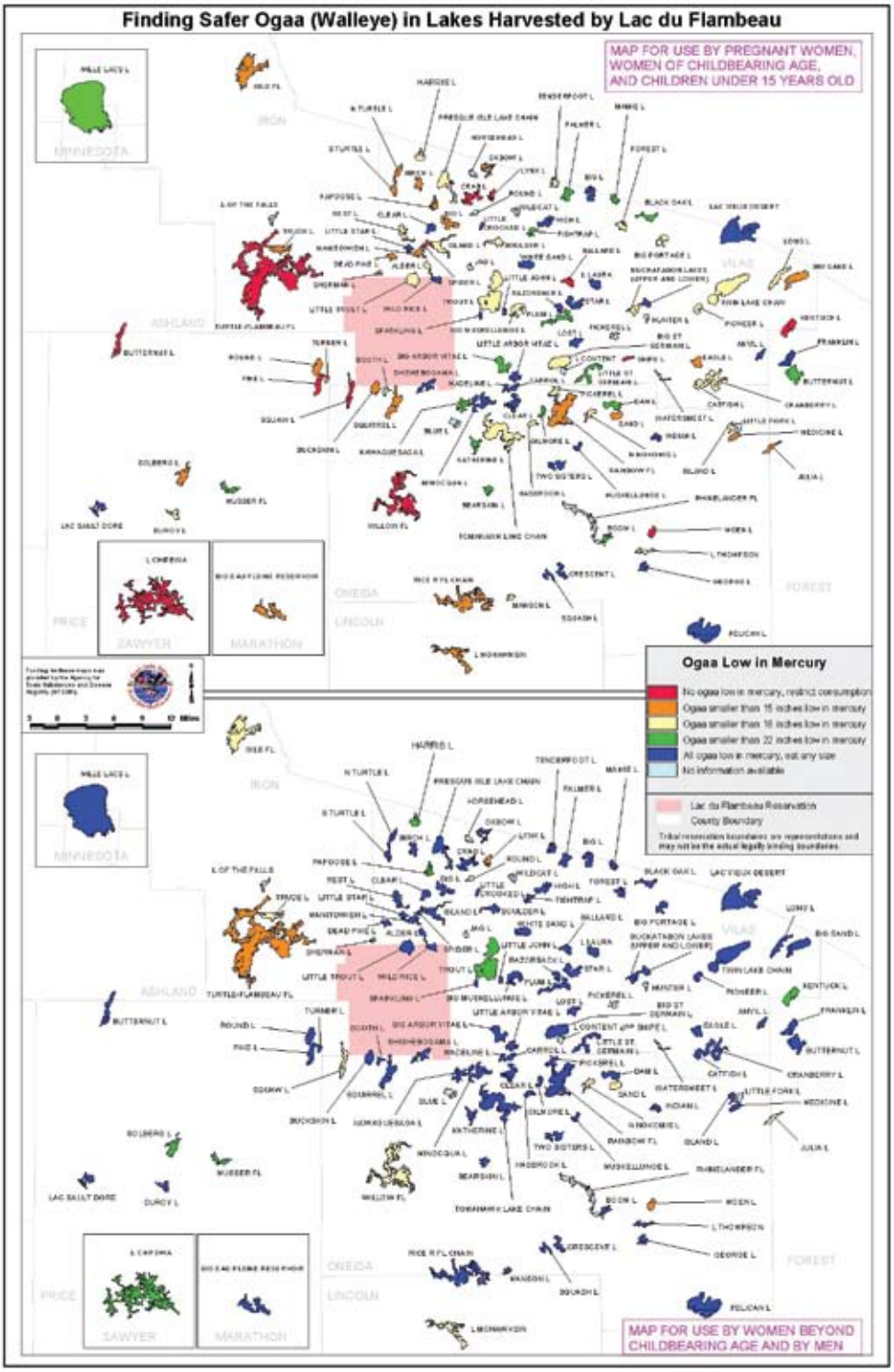
HOW TO USE THESE MAPS TO FIND SAFER *OGAA* (WALLEYE).	***Ogaa* Consumption Advice**
1. **Choose a Map**. Are you making *ogaa* consumption choices for pregnant women, women of childbearing age, breast feeding mothers, or children under 15 years old? **If YES**. Use the map titled "Map for use by pregnant women, women of childbearing age and children under 15 years old". **If NO**. Use the map titled "Map for use by women beyond childbearing age and by men". 2. **Locate a lake**. Compare its color to the map's color key and carefully consider the advice.	**"red"** Top Map: Do not eat *ogaa* greater than 15 inches. Only eat 1 meal per month of *ogaa* less than 15 inches but this should be the only meal of *ogaa* you eat in a month. Bottom Map: Only eat 1 meal per month of any size *ogaa*. **"orange"** Eat *ogaa* smaller than 15 inches in your normal way, and restrict consumption (see below) of *ogaa* larger than 15 inches. **"yellow"** Eat *ogaa* smaller than 18 inches in your normal way, and restrict consumption (see below) of *ogaa* larger than 18 inches. **"green"** Eat *ogaa* smaller than 22 inches in your normal way, and restrict consumption (see below) of *ogaa* larger than 22 inches. **"blue"** Eat any size *ogaa* in your normal way. **"light blue"** No information available. Restrict Consumption of *Ogaa* Advice. Top Map - eat no more than one meal of these larger sized *ogaa* per month but then this should be the only meal of *ogaa* you eat in a month. Bottom Map - eat no more than one meal of these larger sized *ogaa* per month in combination with the *ogaa* you normally would eat; or eat no more than 2 meals per month, but then these should be the only 2 meals of *ogaa* you eat in a month.

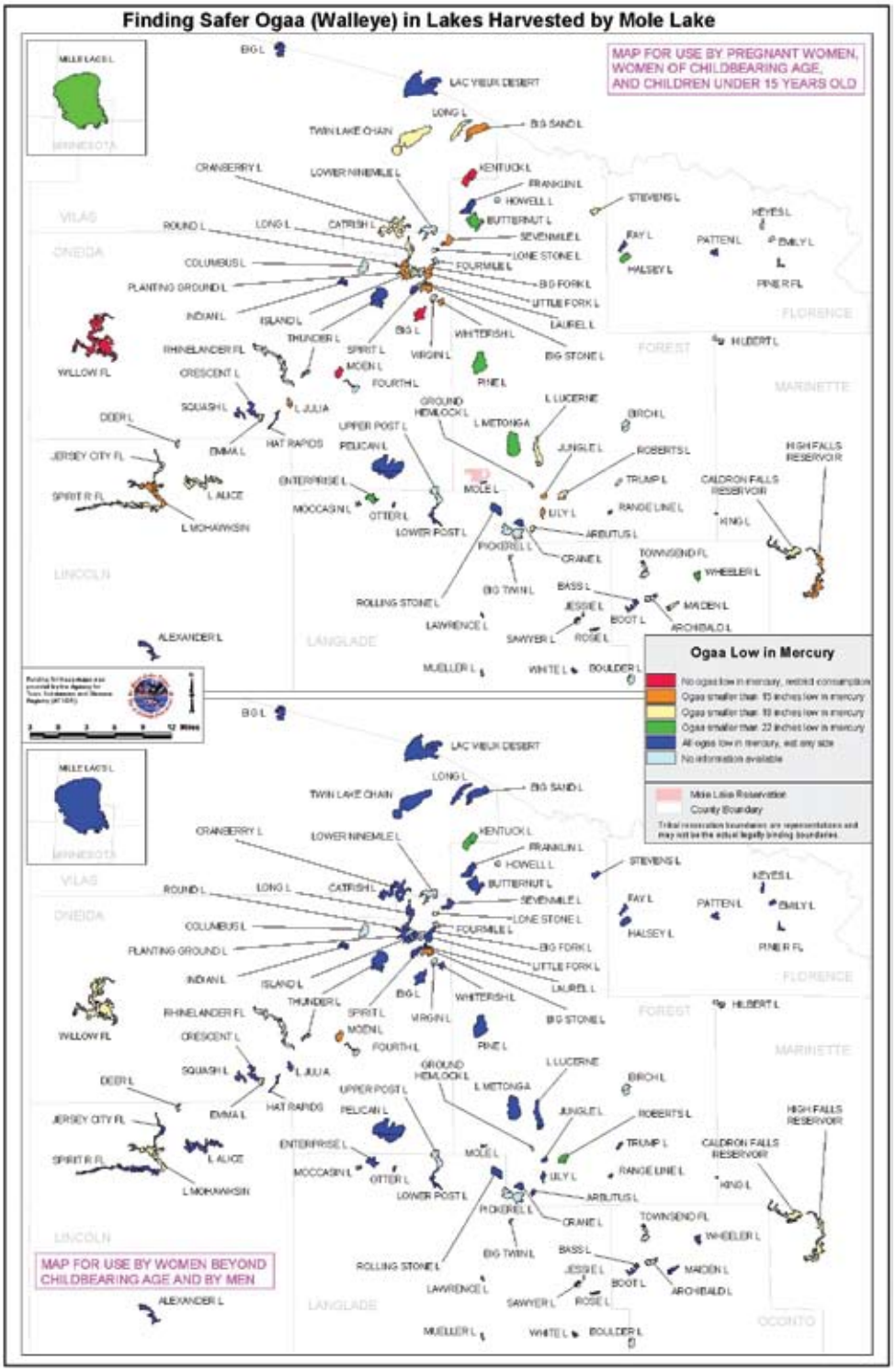
LABELING *OGAA* PRIOR TO FREEZING :
When saving *ogaa* for later, mark or label freezer bags so you know which *ogaa* are safe for consumption by pregnant women, women of childbearing age, breast feeding mothers, and children under 15 years old. For example, you could write on the freezer bag "safe for mom and kids".

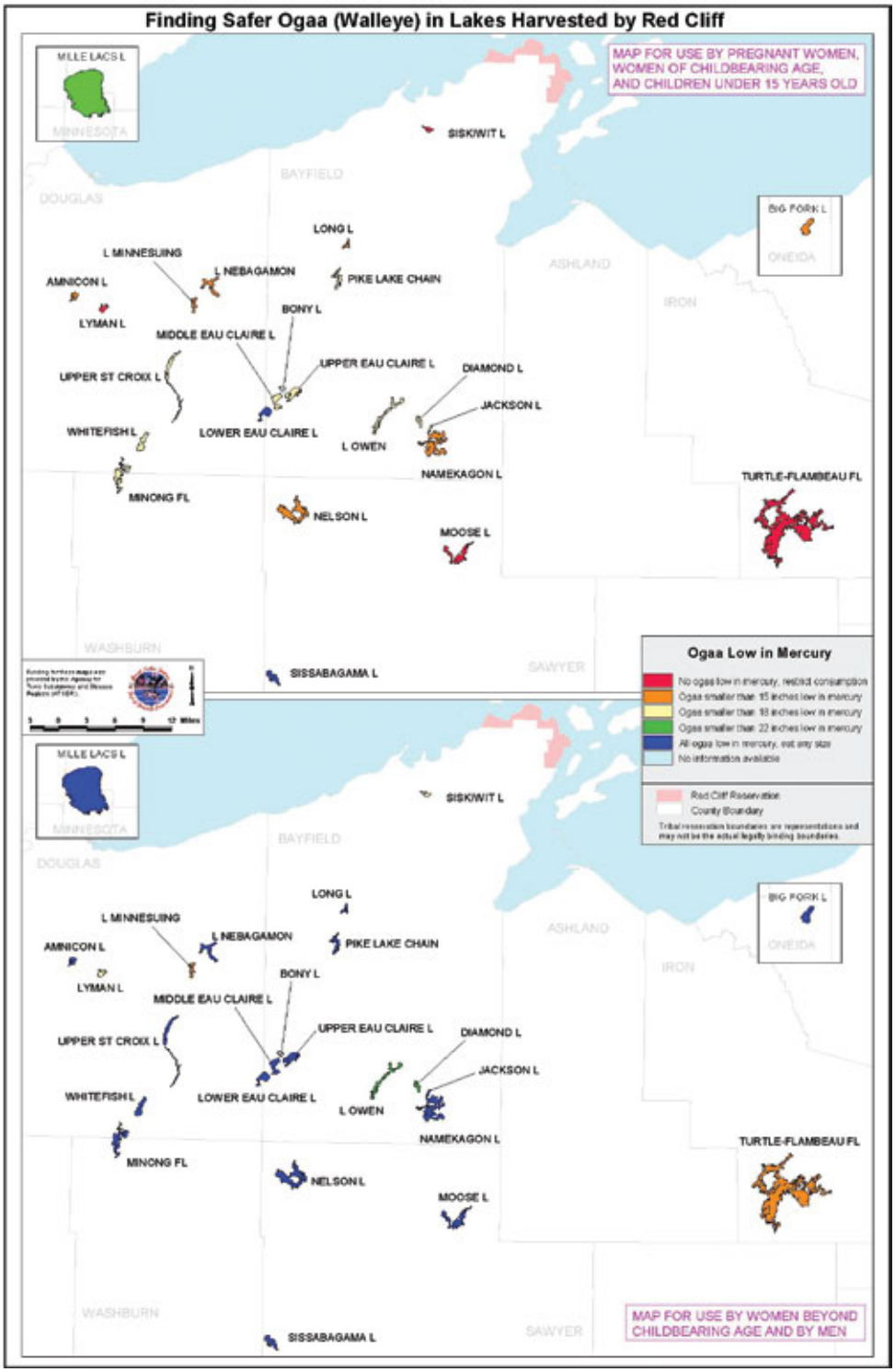
GENERAL ADVICE FOR FINDING SAFER *GIIGOONH*	**RISKS VS BENEFITS OF EATING *GIIGOONH***
In Lakes • Use these maps to find lakes and sizes of *ogaa* that are lower in methyl mercury. • Lakes with lower levels of methyl mercury in the *ogaa* should also have lower levels of methyl mercury in other types of *giigoonh*. **Type of *giigoonh*** • Generally, top predator *giigoonh* such as *ogaa*, muskellunge, largemouth bass, smallmouth bass, and northern pike will have more methyl mercury than *giigoonh* such as lake whitefish, herring, bluegill, sunfish, crappie or perch. **Size (Length)** • Eat smaller *giigoonh*, they will likely have lower amounts of methyl mercury.	Benefit: Nutrients in fish, especially oily fish, may improve the mental development and vision of babies. Lake Superior whitefish and herring contain these beneficial nutrients and are low in methyl mercury. Risk: Remember, mercury can damage the nervous system, especially the brain. Fetuses and babies are the most at risk because their nervous systems are rapidly developing. Children exposed to unsafe levels while in the womb have been found to experience delayed development in walking and talking, even though the mother was not affected. Benefit: Eating even as few as two to three meals of *giigoonh* a month may greatly reduce your risk of death due to heart disease.

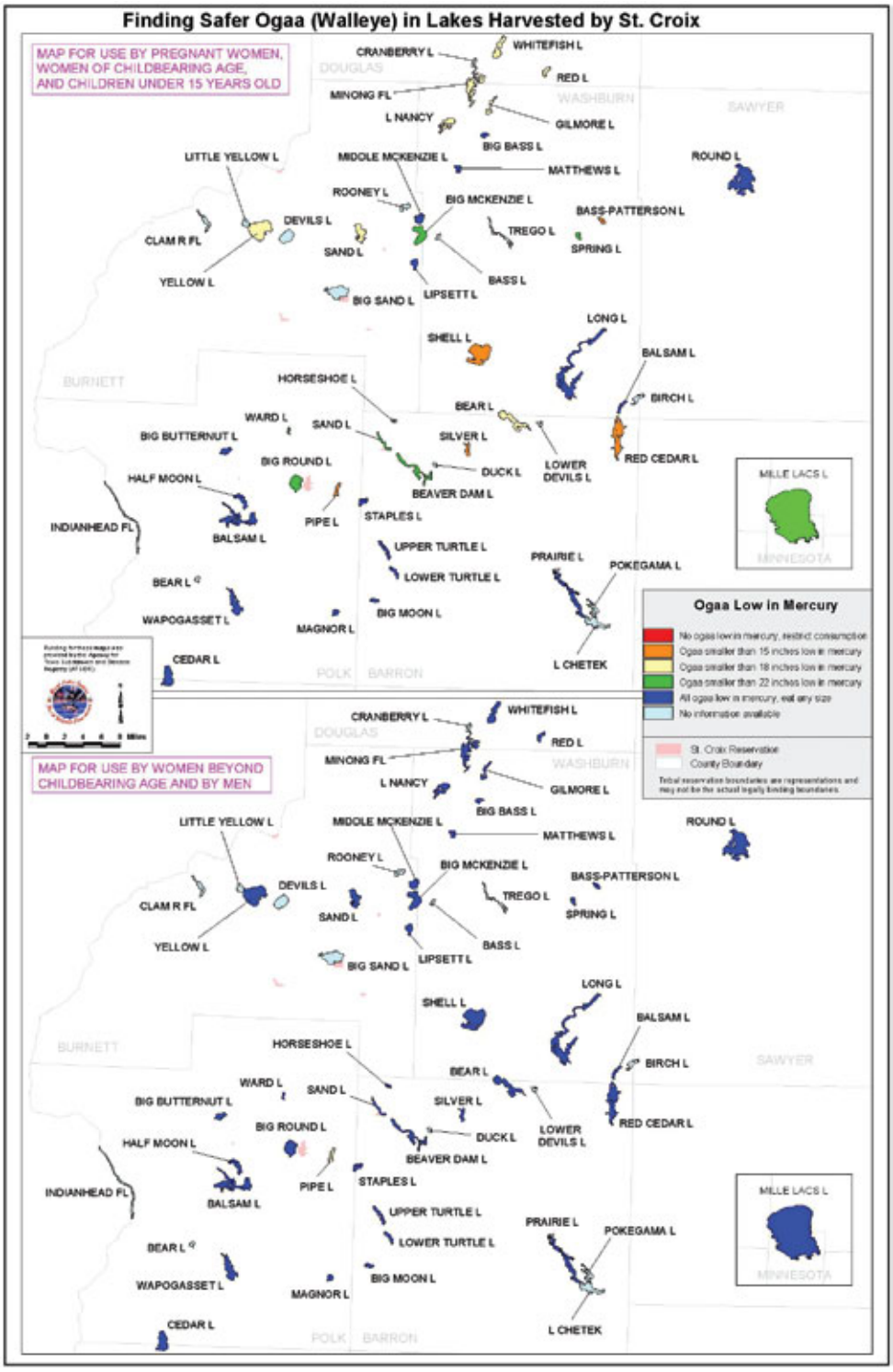

Finding Safer Ogaa (Walleye) in Lakes Harvested by Bad River
MAP FOR USE BY PREGNANT WOMEN, WOMEN OF CHILDBEARING AGE, AND CHILDREN UNDER 15 YEARS OLD
MAP FOR USE BY WOMEN BEYOND CHILDBEARING AGE AND BY MEN
Ogaa Low in Mercury
No ogaa low in mercury, restrict consumption
Ogaa smaller than 15 inches low in mercury
Ogaa smaller than 18 inches low in mercury
Ogaa smaller than 22 inches low in mercury
All ogaa low in mercury, eat any size
No information available
Bad River Reservation
County Boundary
Tribal reservation boundaries are representations and may not be the actual legally binding boundaries
MILLE LACS L
MINNESOTA
CLAM RIVER FL
BURNETT
SISKIWIT L
DOUGLAS
BAYFIELD
RIB L
TAYLOR
WHEELER L
OCONTO
AMNICON L
L MINNESUNG
DOWLING L
UPPER EAU CLAIRE L
MIDDLE EAU CLAIRE L
DIAMOND L
L OWEN
NAMEKAGON L
IRON
ASHLAND
ENGLISH L
N TURTLE L
PRESQUE ISLE LAKE CHAIN
FISHER L
HARRIS L
ANNABELLE L
LONG L
PINE L
OXBOW L
TENDERFOOT L
SPIDER L
ECHO L
LYNX L
MAMIE L
GORDON L
TRUDE L
BIRCH L
CRAB L
FOREST L
LAKE OF THE FALLS
S TURTLE L
FISHTRAP L
HIGH L
TURTLE-FLAMBEAU FL
LOST CANOE L
BLACK OAK L
WHITEFISH L
BOND L
MINONG FL
WASHBURN
NELSON L
TEAL L
BEAR L
ISLAND L
RUSK
CHAIN L
LONG L
HOLCOMBE FL
LOST LAND L
BUTTERNUT L
ROUND L
VILAS
PIKE L
SQUAW L
RAINBOW FL
DUNN
TAINTER L
L WISSOTA
CONNORS L
SOLBERG L
TURNER L
ONEIDA
LAC SAULT DORE
DUROY L
LONG L
SAWYER
CHIPPEWA
BARRON
HEMLOCK L
DAIRYLAND RESERVOIR
PRICE


Finding Safer Ogaa (Walleye) in Lakes Harvested by Lac Courte Oreilles
MAP FOR USE BY PREGNANT WOMEN, WOMEN OF CHILDBEARING AGE, AND CHILDREN UNDER 15 YEARS OLD
NELSON L
SPIDER L
LOST LAND L
LOWER CLAM L
SMITH L
TIGER CAT FL
TEAL L
ROUND L
LITTLE ROUND L
MOOSE L
GRINDSTONE L
DURPHEE L
LAC COURTE OREILLES
L CHIPPEWA
BARBER L
STONE L
WHITEFISH L
MASON L
SAND L
LONG L
SISSABAGAMA L
L OF THE PINES
L CHETAC
BIRCH L
WINDFALL L
WASHBURN
SAWYER
RUSK
OTTER L
CHIPPEWA
EAU CLAIRE
L EAU CLAIRE
MILLE LACS L
MINNESOTA
THORNAPPLE FL
LADYSMITH FL
AMACOY L
POTATO L
PULASKI L
FIRESIDE LAKES
SAND L
ROUND L
HOLCOMBE FL
CHIPPEWA
Ogaa Low in Mercury
No ogaa low in mercury, restrict consumption
Ogaa smaller than 15 inches low in mercury
Ogaa smaller than 18 inches low in mercury
Ogaa smaller than 22 inches low in mercury
All ogaa low in mercury, eat any size
No information available
Lac Courte Oreilles Reservation
County Boundary
Tribal reservation boundaries are representations and may not be the actual legally binding boundaries.
MAP FOR USE BY WOMEN BEYOND CHILDBEARING AGE AND BY MEN


Finding Safer Ogaa (Walleye) in Lakes Harvested by Lac du Flambeau
MAP FOR USE BY PREGNANT WOMEN, WOMEN OF CHILDBEARING AGE, AND CHILDREN UNDER 15 YEARS OLD
Ogaa Low in Mercury
No ogaa low in mercury, restrict consumption
Ogaa smaller than 15 inches low in mercury
Ogaa smaller than 18 inches low in mercury
Ogaa smaller than 22 inches low in mercury
All ogaa low in mercury, eat any size
No information available
Lac du Flambeau Reservation
County Boundary
Tribal reservation boundaries are representations and may not be the actual legally binding boundaries.
MAP FOR USE BY WOMEN BEYOND CHILDBEARING AGE AND BY MEN


Finding Safer Ogaa (Walleye) in Lakes Harvested by Mole Lake
MAP FOR USE BY PREGNANT WOMEN, WOMEN OF CHILDBEARING AGE, AND CHILDREN UNDER 15 YEARS OLD
MAP FOR USE BY WOMEN BEYOND CHILDBEARING AGE AND BY MEN
Ogaa Low in Mercury
No ogaa low in mercury, restrict consumption
Ogaa smaller than 15 inches low in mercury
Ogaa smaller than 18 inches low in mercury
Ogaa smaller than 22 inches low in mercury
All ogaa low in mercury, eat any size
No information available
Mole Lake Reservation
County Boundary
Tribal reservation boundaries are representations and may not be the actual legally binding boundaries.
MILLE LACS L.
MINNESOTA
VILAS
ONEIDA
LINCOLN
LANGLADE
FLORENCE
FOREST
MARINETTE
OCONTO
BIG L.
LAC VIEUX DESERT
TWIN LAKE CHAIN
LONG L.
BIG SAND L.
CRANBERRY L.
LOWER NINEMILE L.
KENTUCK L.
FRANKLIN L.
HOWELL L.
BUTTERNUT L.
SEVENMILE L.
LONE STONE L.
FOURMILE L.
BIG FORK L.
LITTLE FORK L.
LAUREL L.
STEVENS L.
FAY L.
HALSEY L.
PATTEN L.
KEYES L.
EMILY L.
PINE R FL.
ROUND L.
CATFISH L.
COLUMBUS L.
PLANTING GROUND L.
INDIAN L.
ISLAND L.
THUNDER L.
SPIRIT L.
MOEN L.
FOURTH L.
VIRGIN L.
WHITEFISH L.
BIG STONE L.
PINE L.
HUBERT L.
RHINELANDER FL.
WILLOW FL.
CRESCENT L.
SQUASH L.
L. JULIA
HAT RAPIDS
EMMA L.
DEER L.
JERSEY CITY FL.
SPIRIT R FL.
L. ALICE
L MOHAWKSIN
UPPER POST L.
PELICAN L.
GROUND HEMLOCK L.
L METONGA
L LUCERNE
BIRCH L.
JUNGLE L.
ROBERTS L.
TRUMP L.
RANGE LINE L.
ULY L.
ENTERPRISE L.
MOCCASIN L.
OTTER L.
MOLE L.
LOWER POST L.
ARBUTUS L.
PICKEREL L.
CRANE L.
BIG TWIN L.
ROLLING STONE L.
LAWRENCE L.
SAWYER L.
ROSE L.
MUELLER L.
WHITE L.
BOULDER L.
BASS L.
JESSIE L.
BOOT L.
MAIDEN L.
ARCHIBALD L.
TOWNSEND FL.
WHEELER L.
HIGH FALLS RESERVOIR
CALDRON FALLS RESERVOIR
KING L.
ALEXANDER L.


Finding Safer Ogaa (Walleye) in Lakes Harvested by Red Cliff
MAP FOR USE BY PREGNANT WOMEN, WOMEN OF CHILDBEARING AGE, AND CHILDREN UNDER 15 YEARS OLD
MILLE LACS L
MINNESOTA
SISKIWIT L
BAYFIELD
DOUGLAS
BIG FORK L
ONEIDA
ASHLAND
IRON
LONG L
L MINNESUING
L NEBAGAMON
PIKE LAKE CHAIN
AMNICON L
LYMAN L
BONY L
MIDDLE EAU CLAIRE L
UPPER EAU CLAIRE L
DIAMOND L
UPPER ST CROIX L
JACKSON L
WHITEFISH L
LOWER EAU CLAIRE L
L OWEN
NAMEKAGON L
TURTLE-FLAMBEAU FL
MINONG FL
NELSON L
MOOSE L
WASHBURN
SAWYER
SISSABAGAMA L
Ogaa Low in Mercury
No ogaa low in mercury, restrict consumption
Ogaa smaller than 15 inches low in mercury
Ogaa smaller than 18 inches low in mercury
Ogaa smaller than 22 inches low in mercury
All ogaa low in mercury, eat any size
No information available
Red Cliff Reservation
County Boundary
Tribal reservation boundaries are representations and may not be the actual legally binding boundaries.
MAP FOR USE BY WOMEN BEYOND CHILDBEARING AGE AND BY MEN


Finding Safer Ogaa (Walleye) in Lakes Harvested by St. Croix
MAP FOR USE BY PREGNANT WOMEN, WOMEN OF CHILDBEARING AGE, AND CHILDREN UNDER 15 YEARS OLD
MAP FOR USE BY WOMEN BEYOND CHILDBEARING AGE AND BY MEN
CRANBERRY L
WHITEFISH L
RED L
MINONG FL
L NANCY
GILMORE L
BIG BASS L
MATTHEWS L
ROUND L
LITTLE YELLOW L
MIDDLE MCKENZIE L
ROONEY L
BIG MCKENZIE L
BASS-PATTERSON L
DEVILS L
CLAM R FL
SAND L
TREGO L
SPRING L
YELLOW L
BASS L
LIPSETT L
BIG SAND L
LONG L
SHELL L
BALSAM L
BIRCH L
HORSESHOE L
BEAR L
WARD L
SAND L
SILVER L
BIG BUTTERNUT L
RED CEDAR L
LOWER DEVILS L
BIG ROUND L
DUCK L
HALF MOON L
BEAVER DAM L
PIPE L
STAPLES L
INDIANHEAD FL
BALSAM L
UPPER TURTLE L
LOWER TURTLE L
PRAIRIE L
POKEGAMA L
BEAR L
WAPOGASSET L
MAGNOR L
BIG MOON L
L CHETEK
CEDAR L
MILLE LACS L
MINNESOTA
BURNETT
DOUGLAS
WASHBURN
SAWYER
POLK
BARRON
Ogaa Low in Mercury
No ogaa low in mercury, restrict consumption
Ogaa smaller than 15 inches low in mercury
Ogaa smaller than 18 inches low in mercury
Ogaa smaller than 22 inches low in mercury
All ogaa low in mercury, eat any size
No information available
St. Croix Reservation
County Boundary

Appendix K:
San Francisco Bay Outreach Materials

THE CALIFORNIA DEPARTMENT OF HEALTH SERVICES
ENVIRONMENTAL HEALTH INVESTIGATIONS BRANCH

SAN FRANCISCO BAY SEAFOOD CONSUMPTION STUDY

General Information

APRIL 2001

Q: Why was the San Francisco Bay Seafood Consumption Study done?

A: In 1994, the Regional Water Quality Control Board (RWQCB) conducted a pilot study of fish from the San Francisco Bay. The study found mercury, polychlorinated biphenyls (PCBs), and pesticides in fish at levels that could be harmful to human health if eaten often. Based on this study, the Office of Environmental Health Hazard Assessment (OEHHA) released a health advisory for the Bay, recommending limits on how much fish one can safely eat. To learn more about who is eating fish from the Bay, the San Francisco Estuary Institute's Regional Monitoring Program (RMP) funded the California Department of Health Services (CDHS) to conduct the San Francisco Bay Seafood Consumption Study in 1998.

The goals of the study were to:

- gather information on San Francisco Bay anglers and their fish consumption habits
- identify anglers who are at risk due to their fish consumption habits
- gather information to help develop educational programs about safe fish consumption from the Bay

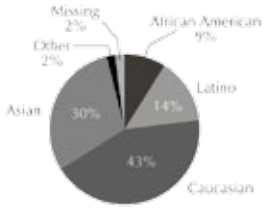
Q: How was the San Francisco Bay Seafood Consumption Study done?

A: This study is the largest consumption study ever conducted in San Francisco Bay. Over 1,300 anglers were interviewed over a 12 month period in 1998 and 1999. CDHS interviewed people fishing on piers and shorelines, as well as people fishing from private and party boats. Everyone over 18 years of age who was fishing was interviewed. The interview included questions about the angler's ethnicity, household income, education, amount and type of Bay fish consumed, parts of the fish eaten, and awareness of the health advisory for San Francisco Bay fish. Interviewers were able to speak English and at least one other language, including Spanish, Vietnamese, Cantonese, or Mandarin.

Q: Who is eating fish from the Bay?

A: Eighty-seven percent of anglers interviewed for the study ate fish from the Bay. As shown in Figure 1, Caucasians were the largest group of consumers of Bay fish, followed by Asians, Latinos, and African Americans. Many anglers reported that women of childbearing age (between 18 and 45 years of age) and young children in the household ate their catch as well.

Figure 1. Ethnicity of Consumers of Bay Fish



Q: How much fish from the Bay is safe to eat?

A: The health advisory recommends that adults limit their consumption of San Francisco Bay fish to **no more than two meals a month.** Adults also should not eat striped bass over 35 inches in length because larger fish often contain more chemicals, and larger striped bass contains more mercury than most fish. Women who are pregnant, breastfeeding, or may become pregnant should not eat more than one meal per month. In addition, they should not eat any meals of striped bass over 27 inches, or shark over 24 inches. Children under the age of six should not eat more than one meal per month.

The advisory defines the size of a meal based on body weight, roughly one ounce of uncooked fish per 20 pounds of body weight. For example, a meal size for a person weighing 160 pounds is about 8 ounces, or half a pound. Therefore, an adult weighing 160 pounds can safely eat two half pound meals of fish a month, or a total of one pound a month. People who eat smaller portions of fish can safely eat more than two meals, as long as they don't eat more than the advisory recommends per month.

These limits only apply to fish caught in the San Francisco Bay, but do not include salmon, anchovies, herring, and smelt caught in the Bay.

The health advisory also recommends cooking and preparing fish in ways that reduce the amount of contaminants. These include eating only the fish fillet, and throwing away the guts, skin and fatty parts of the fish. Since chemicals build up in the fatty parts of the fish, cooking the fish in ways that allow the juices (which contain fat) to drain away and be discarded is also advised. Fishing in different places and eating a variety of fish are also recommended.

QUESTIONS AND ANSWERS

Q: How much fish are people eating from the Bay?

A: Interviewers asked anglers how much fish they ate from the Bay in the four weeks prior to the interview (last four weeks). Among anglers who ate Bay fish, 80% reported eating about one meal or less in the last four weeks, 10% ate about two meals, and another 10% ate more than two meals. African-Americans and Filipinos ate the most fish, and Caucasians ate the least. Asians and people with lower incomes and education, however, were more likely to eat white croaker, a fish also called kingfish that is more likely to contain chemicals. Asians were also more likely to eat the skin and other fatty parts of the fish where these chemicals build up.

Q: Who is eating more than is recommended?

A: Most anglers who had eaten fish did so within the advisory limits of two meals a month, or about one pound a month of advisory fish. However, one in ten ate more than what the advisory recommends. Anglers who ate more than the advisory recommends came from all ethnic groups and backgrounds. Asians and African-Americans, however, were more likely to eat above the limit.

Q: Are anglers aware of the advisory for San Francisco Bay fish?

A: Sixty-one percent of anglers we interviewed were aware that there is a health advisory for San Francisco Bay. African-American and Caucasian anglers were more likely to be aware of the advisory than were Latinos and Asians. Awareness of the advisory also increased with both income and education.

Only 34% of the anglers we interviewed were aware of one or more of the recommendations in the health advisory, such as limiting how much fish they ate, or eating only the fillet (meat) of the fish.

Q: What is CDHS recommending?

A: CDHS and the RMP recommend that anglers consume fish within the advisory limits, and use fish preparation and cooking methods that reduce the level of contaminants in fish. We also recommend that continued outreach and education efforts be directed to all anglers, informing them about the advisory and safer preparation and cooking methods. Warning signs should be posted in areas where anglers fish. Outreach activities should also be targeted toward anglers who eat more than the advisory recommends, or whose consumption habits place them at higher risk. Educational messages should be developed that are culturally appropriate, and should focus on consumption limits and safer practices. In addition, efforts should be made to include community-based organizations in the education efforts, and to provide funds to develop and produce educational materials. Although this study provided information on many aspects of fish consumption by people fishing in the Bay, further steps should be taken to characterize habits of other household members who consume Bay fish and to determine which educational messages are the most effective.

For More Information

For information about the study, or about education and outreach to anglers, contact:

Diana Lee, Alyce Ujihara, or Ian Walker
Environmental Health Investigations Branch
California Department of Health Services
1515 Clay Street, 17th Floor
Oakland, CA 94612
(510) 622-4500
www.dhs.ca.gov/ehib

For information about health advisories for the San Francisco Bay and other areas of California, contact:

Margy Gassel
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency
1515 Clay St., 16th Floor
Oakland, CA 94612
(510) 622-3166
www.oehha.ca.gov

For information about the data from the study and the Regional Monitoring Program, contact:

Rainer Hoenicke, RMP Manager
San Francisco Estuary Institute
180 Richmond Field Station
1325 South 46th Street
Richmond, CA 94804
(510) 231-9539
www.sfei.org

For information about clean-up measures in the Bay, contact:

Wil Bruhns
San Francisco Bay Regional Water Quality Control Board
1515 Clay St., 15th Floor
Oakland, CA 94612
(510) 622-2327
www.swrcb.ca.gov/~rwqcb2

Questions and Answers

THE CALIFORNIA DEPARTMENT OF HEALTH SERVICES
ENVIRONMENTAL HEALTH INVESTIGATIONS BRANCH

SAN FRANCISCO BAY SEAFOOD CONSUMPTION STUDY

Information for People who Fish

APRIL 2001

Many anglers are concerned about the fish they catch from the San Francisco Bay. A 1994 study found high levels of mercury, polychlorinated biphenyls (a group of chemicals called PCBs) and pesticides in Bay fish. In 1998, the San Francisco Estuary Institute (SFEI) asked the California Department of Health Services (CDHS) to conduct The San Francisco Bay Seafood Consumption Study.

The goals of the study were to:

- gather information on San Francisco Bay anglers and their fish consumption habits
- identify anglers who are at risk due to their fish consumption habits
- gather information to help develop educational programs about safe fish consumption from the Bay

Q: Why think about the fish you eat?

A: Fish are an important part of a healthy diet. However, fish from the San Francisco Bay contain chemicals that may be harmful to your health if eaten often. Based on the 1994 study, the Office of Environmental Health Hazard Assessment (a California government agency) released a health advisory for the Bay. This advisory makes recommendations about how much fish one can safely eat from the San Francisco Bay.

Q: How much fish from the Bay is safe to eat?

A: The health advisory recommends that adults limit their consumption of San Francisco Bay fish to **no more than two meals a month**. Adults also should not eat striped bass over 35 inches in length because larger fish often have more chemicals and striped bass has more mercury than most fish. Women who are pregnant, breastfeeding, or may become pregnant should not eat more than one meal a month. In addition, they should not eat any meals of striped bass over 27 inches, or shark over 24 inches. Children under the age of six should not eat more than one meal a month.

The advisory defines the size of a meal based on body weight, roughly one ounce of uncooked fish per 20 pounds of body weight. For example, a meal size for a person weighing 160 pounds is about 8 ounces, or half a pound. Therefore, an adult weighing 160 pounds can safely eat **two** half pound meals of fish a month, or a total of one pound a month. People who eat smaller portions of fish can safely eat more than two meals, as long as they don't eat more than the advisory recommends per month.

These limits apply to most fish caught in the San Francisco Bay, but do not include salmon, anchovies, herring, and smelt.

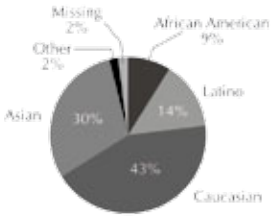
Q: How was the San Francisco Bay Seafood Consumption Study done?

A: The San Francisco Bay Seafood Consumption Study is the largest consumption study ever conducted in the SF Bay. Over 1,300 San Francisco Bay anglers were interviewed over a 12 month period in 1998 and 1999. CDHS interviewed anglers on fishing piers and shorelines, as well as anglers fishing from private and party boats. Everyone over 18 years of age who was fishing was interviewed. The interview included questions about the angler's ethnicity, education, household income, the amount and type of fish consumed from the Bay, parts of the fish eaten, and awareness of the health advisory for SF Bay fish. Interviewers were able to speak English and at least one other language, including Spanish, Vietnamese, Cantonese, or Mandarin.

Q: Who is eating fish from the Bay?

A: Eighty-seven percent of anglers interviewed for the study ate fish from the Bay. As shown in Figure 1, Caucasians were the largest group of consumers of Bay fish, followed by Asians, Latinos, and African Americans. Many anglers reported that women of childbearing age (between 18 and 45 years of age) and young children in the household ate their catch as well.

Figure 1. Ethnicity of Consumers of Bay Fish



Q: How much fish are people eating from the Bay?

A: Interviewers asked anglers how much Bay fish they had eaten in the last four weeks. Among anglers who ate Bay fish, 80% had eaten one meal or less in the last four weeks, 10% ate two meals and another 10% ate more than two meals. African-Americans and Filipinos ate the most fish and Caucasians ate the least. Asians and people with lower incomes and education, however, were more likely to eat white croaker, a fish also called kingfish, which is more likely to contain chemicals. Asians were also more likely to eat the skin and other fatty parts of the fish where these chemicals build up.

The California Department of Health Services
Environmental Health Investigations Branch

Q: Who is eating more than is recommended?

A: Most anglers who had eaten fish did so within the advisory limits of one pound a month of advisory fish. However, one in ten ate more than what the advisory recommends. Anglers who ate more than the advisory recommends came from all ethnic groups and backgrounds. Asians and African Americans, however, were more likely to eat above the limit.

Q: What will happen if I eat too much fish from the Bay?

A: Eating large amounts of fish from the SF Bay will not make you sick right away. However, eating large amounts of Bay fish for many years may increase your risk of developing cancer or other health problems. Pregnant and breastfeeding women may pass these chemicals on to their developing babies. Mercury and PCBs may increase the chance of developmental problems in infants and children. To be safe, CDHS recommends that you and your family follow the guidelines in the health advisory.

Q: Are anglers aware of the advisory for SF Bay fish?

A: Sixty-one percent of anglers we interviewed were aware that there is a health advisory for the Bay. African-American and Caucasian anglers were more likely to be aware of the advisory than were Latinos and Asians. Awareness of the advisory also increased with both income and education.

Only 34% of the anglers were aware of one or more of the recommendations in the health advisory, such as limiting how much fish they ate, or eating only the fillet (meat) of the fish.

Q: Are there better places to fish?

A: The health advisory applies to fish from all over the San Francisco Bay inside the Golden Gate Bridge, including San Pablo Bay. There are no health advisories for fish in the ocean (outside the Golden Gate Bridge). However, there are health advisories for other areas of California. The Department of Fish and Game's *California Sport Fishing Regulations* booklet contains a list of these advisories. They may also be found on the Internet at:

www.oehha.ca.gov/fish.html and

www.dfg.ca.gov/regs.html

Q: Are store bought fish safer to eat?

A: The federal Food and Drug Administration (FDA) is responsible for making sure that fish and other products in the store are safe. In general, the fish you buy in a store or restaurant is safe to eat. However, FDA recommends that women who are pregnant, planning to become pregnant, or nursing, and young children should **not** eat any shark, swordfish, king mackerel, and tilefish because they contain higher levels of mercury. FDA also advises women who are pregnant or planning to become pregnant to eat a variety of fish. These women can safely eat 12 ounces per week of cooked store bought fish per week. More information about FDA's advice can be found by calling (888) SAFEFOOD, or on the Internet at www.cfsan.fda.gov.

Q: What does CDHS recommend?

A: CDHS, OEHHA and other health experts recommend that anglers follow the guidelines in the health advisory. Whenever possible, anglers should catch, prepare, and cook their fish using methods that reduce the level of chemical contaminants in fish. Safer methods include:

- Eat only the fillet.
- Throw away the guts, skin, and fatty parts of the fish. Many chemicals build up in these parts.
- Bake, broil, grill or steam fish so that the juices drain away. Throw away all the fat and cooking juices.
- Eat the types of fish that are not included in the advisory, such as salmon, smelt, anchovies, and herring.
- Eat a variety of fish, not just one type of fish.
- Fish in a variety of locations.

CDHS also recommends that educational efforts be directed towards anglers who eat more fish, or who prepare and cook their fish in ways that may increase their risk for health problems. Educational messages should be developed that are culturally appropriate, and should focus on consumption limits and safer ways of preparing and cooking fish. Signs informing people about the advisory should also be posted in areas where anglers fish.

For More Information

For information about the study, or about education and outreach to anglers, contact:

Diana Lee, Alyce Ujihara, or Ian Walker

Environmental Health Investigations Branch,
California Department of Health Services
1515 Clay Street, 17th Floor
Oakland, CA 94612

(510) 622-4500

www.dhs.ca.gov/ehib

For information about the data from the study and the Regional Monitoring Program, contact:

Rainer Hoenicke,
RMP Manager

San Francisco Estuary Institute
180 Richmond Field Station
1325 South 46th Street
Richmond, CA 94804

(510) 231-9539

www.sfei.org

For information about health advisories for the San Francisco Bay and other areas of California, contact:

Margy Gassel

Office of Environmental Health Hazard Assessment,
California Environmental Protection Agency
1515 Clay St., 16th Floor
Oakalnd, CA 94612

(510) 622-3166

www.oehha.ca.gov


AVISO
WARNING
警告事項
BABALA
LƯU Ý!
Fish in the San Francisco Bay have chemicals that may harm your health. Pregnant and breastfeeding women, and children under six years should eat no more than one meal of fish a month. Other adults may safely eat up to two meals of fish a month.
Los peces de las aguas de la Bahía de San Francisco contienen sustancias químicas que pueden afectar su salud. Las mujeres embarazadas y amamantando, así como los niños menores de 6 años, no deben de comer más de una comida de este pescado al mes. Otros adultos pueden comer con seguridad hasta dos veces al mes.
Maaaring magkaroon ng masasamang kemikal ang mga isdang huli sa San Francisco Bay na makakapinsala sa inyong katawan. Dapat kumain ng isang beses lamang sa isang buwan ang mga buntis at mga nagpapasuso ng sanggol, kasama ng mga bata hanggang anim na taong gulang. Maaaring kumain hanggang dalawang beses sa isang buwan ang mga ibang nakakatanda.
Pregnant women
Breastfeeding women
Children under 6 years
1 MEAL A MONTH
EAT ONLY THE FILLET
NO Striped Bass over 27"
NO shark
Adults
2 MEALS A MONTH
EAT ONLY THE FILLET
NO Striped Bass over 35"
三藩市灣區的魚獲含有化學物質可能危害你的健康。懷孕和哺乳中的婦女、及六歲以下的小孩每月只可吃一餐；其他的成年人也只可每月吃兩餐此等魚獲。
Cá trong Vùng Vịnh San Francisco bị nhiễm chất hóa học có th nguy hại cho sức khỏe. Những thai phụ hoặc những bà mẹ đang cho con b , và những con em dưới 6 tuổi chỉ nên n 1 bữa n có cá trong một tháng. Những người lớn khác có th n 2 bữa n có cá trong một tháng.
These limits are for all fish except salmon, anchovies, herring and smelt, which contain fewer chemicals.
EAT BAY FISH SAFELY

Appendix L :
Full Text of Presentation by Dr. Stuart Harris

Luncheon talk at the Annual National Forum on Contaminants in Fish
Sponsored by EPA, MN Dept of Health, SRA
Chicago; Holiday Inn Mart Plaza, May 9, 2001

IMPACTS OF FISH CONTAMINATION ON NATIVE AMERICAN CULTURE

Stuart Harris, Natural/Cultural Resources Coordinator, SSRP Program, Confederated Tribes of the Umatilla Indian Reservation, PO Box 638, Pendleton OR 97801;
stuartharris@ctuir.com. **541/966-2408.**

Good afternoon, I'd like to begin by thanking the Conference organizers and the EPA for bringing us all together today. It's customary where I'm from, to also wish you a safe journey home and that you find your home in the same condition that you left it in.

How many of you have a 401K or a retirement account? Raise your hands. How are your accounts doing? Well, my fish are my retirement account, and they are not doing very well. Your accounts may be down 50% but are recovering. My account is down 99% and seems to be at risk of disappearing altogether.

I am here to speak to you about cultural impacts derived from fish contaminants and fish advisories. The task of informing a population about what is in their fish, and how much, what type, or what part, of a fish they can consume is no small thing. Information from many different places has to be integrated. When an advisory impacts a Sovereign Nation such as a Treaty Tribe, ALL of the factors associated with the Advisory and how it may impact that Sovereign Nation have to be taken into account.

I am a staff scientist for the Confederated Tribes of the Umatilla Indian Reservation, or CTUIR. My job is to analyze the risks to our people and our culture from pollution impacts. I have to protect my people's treaty rights, resources, culture, and reservation. I have to educate my people about any hazards stemming from pollution. I also get opportunities to educate regulators and academia about what pollution impacts mean to my culture and the health and future of my children and all the children to come.

The CTUIR is a sovereign government that has a legal interest in the natural resources upon which the CTUIR's treaty rights are based. The federal government, when it entered into this treaty, affirmed that it has both a moral and legal fiduciary obligation to protect the natural resources upon which our treaty is based. The United State government made a legally binding promise when it signed our treaty, and this obligation extends to all parts of the federal government. This obligation does not fade with time and it extends far into the future. The United States Constitution refers to all treaties as "the supreme law of the land." Therefore, upholding our Treaty is a constitutional duty that extends to all federal agencies. Tribes have at least the status of states, and many tribal governments were established by Treaties long before the states where they are now located came into being.

The CTUIR or Umatilla Indian Reservation, is located in northeastern Oregon near Pendleton, Oregon, and is occupied by the descendants of three Columbia Plateau Tribes – the Cayuse, the Walla Walla, and the Umatilla Tribes. My family and relatives have lived within the Columbia River watershed for thousands and thousands of years. The river and all of the inter-dependent resources have sustained us both physically and spiritually for that whole time.

Our elders tell us about the creation of the world. First, the Creator made the world and the oceans. The Fish and the food they eat were the first people. Then the Creator made the deer, the coyote, other animals, and their foods. He made the roots and berries and medicines. Everything was as it should be, but after a little while Itsiyaya (Coyote) said "Everything is good, but something is missing." So the Creator created humanoids. They came without instructions and had to be trained, just like any coyote pup. The Creator, through the itsiyaya, taught the humanoids about how to be human-beings (these are the real people like the fish people) and to respect the other people and their things in this world, and told humans how to work with them and to use them properly.

We, the Tetokin or Indian People, celebrate our origins at every meal through the telling of these stories and through the placement of the food of our plate. The foods are placed in the order of their creation in a counterclockwise circle on our plates at home and at our ceremonies, the same direction as the solar system turns. Our people know and have known since these stories originated that the Earth spins into the sunrise, and travels counterclockwise around the sun, which in turn travels counterclockwise around the galaxy. We even have ancient symbols and stories that describe the spiral galaxy turning counterclockwise.

My people have many other oral histories or stories. These are not "mythology" or superstitions of an unobservant people, but portray the natural world very accurately. We have stories about early eruptions and their effects, of Mount St. Helens and Mount Mazama or Crater Lake, and about ancestors of modern animals. Our word for elephant, which has been around since those times. We have stories about our people getting caught up in the Missoula Floods, which occurred approximately 16,000 years ago and created the present course of the Columbia River and other landforms. Our oral history story tells about this event, but modern science only "discovered" this within the last 50 years. Our oral histories are the distillation of wisdom about the ecology refined over innumerable generations, not something that needs to be improved by mechanical measurements which are not as sensitive as our own eyes.

Under the Treaty of 1855 [12 Stat. 945], the Tribes ceded lands to the United States yet retained rights to perform cultural activities on those lands, including but not limited to fishing, hunting, gathering roots and berries, and pasturing livestock. Many legal cases have upheld the Treaties and confirmed that the tribes have legal rights to at least half the fish in the Columbia River. The problem today is that 99% of the fish are gone, and every single remaining fish is contaminated to a greater or lesser extent. Plus, the water they live in is contaminated and over-committed to conflicting interests such as hydropower and irrigation.

I do, and will continue, to exercise my Treaty reserved rights to the fullest extent possible. It is important for you to understand that my great-grandparents paid for these rights with their blood. There are thousands of martyrs just like my great-grandparents in the histories of the Native Sovereign Nations throughout these United States. You must work with their descendants

who are still dealing on a daily basis with the memories and consequences. These people, like my relatives, insisted – even when they were held at gunpoint and executed for resisting - that they, their children, and their children's children, must have the resources needed to carry our cultures into the future.

My culture is dependent on, and springs forth from, exercising all the practices, activities, and lifestyles we have developed from a partnership with the ecology, thousands of years ago. I insist that I must be allowed to effectively exercise my treaty rights. I insist that I have the freedom to go about my business without interruption. I insist that I be able to practice my religion just like any of you in this room. And I demand the freedom to consume any and all parts of all the foods that my elders have taught me are the center of our cultural and spiritual lives without fearing for my life or the lives of my children.

I and my family have committed to uphold a spiritual and cultural duty brought down to us young people from our elders. That duty includes the responsibility, for as long as anybody can remember, to cherish and partake of the gifts that are freely given to us. When I was young and full of pride for giving to some charity, one of my elders explained to me that the giving of tithes is a good thing. He then asked me if I would go so far as to offer up one of my limbs for another's dinner. I was shocked as a youngster, at this notion of cutting off my leg for someone's dinner. He continued on, "You think you are so generous, but compared to the tsuyem (the fish) your gift is but a token. They willingly offer up their lives and flesh for us." Yet today, their worth is valued in kilowatt-hours, acre-feet of irrigation water, and parts per billion of pollutants.

The salmon return year after year to the remnants of their homes. Every last one of them fulfills their part of a compact that both our peoples made in the beginning. The development of the modern infrastructure has made it very hard for the fish. Nevertheless the fish willingly die trying to come home because they promised to come and nourish us. We honor them each year when they return, and at every meal, and we try to take care of their home while they are gone to the ocean. We tell our children to be like the fish because they, just like my human elders, selflessly give of themselves for the benefit of the people. We don't club and throw away our fish, just like we don't throw away our elders.

I would hope that you begin to understand that for my children to live full and beautiful lives the health of those natural resources which we subsist on, must be held at the highest level by all. I cannot emphasize enough that the federal government has a fiduciary responsibility to protect our Treaty resources. The states must also recognize that these treaties have been upheld numerous times in court and are the supreme law of the land, and should be treated as ARARs.

I am a Cayuse-Nimipoo. Our traditional environmental knowledge-based culture, which has co-evolved with nature through thousands years of ecological education, has provided my family and relatives with the knowledge that their unique and valid system of holistic environmental management is the truth. That truth being, that our traditional methodologies are the best way to manage a watershed given the limited space, water, and resources, as evidenced by thousands of years of implementation. It is also understood that throughout the year, when my relatives participate in activities such as fishing, hunting and gathering for foods, medicines, ceremonies, and subsistence, the associated activities are as important as the end product. In the Judeo-Christian tradition, an analogy would be "kosher" dietary practices. All of the foods and

implements gathered and manufactured by my traditional brothers and sisters are interconnected in at least one, but more often in many ways. I have met many people who follow cultural teachings or lessons brought down through history from the elders. Our individual and collective well-being is derived from membership in a healthy community. We are trained how to properly access the ancestral lands and gather traditional resources in a continuously sustainable manner. With training, young tribal members such as myself gain the ability to satisfy their personal responsibility to participate in traditional community activities and to help maintain the spiritual quality of our resources.

In preparing to come here today, I asked many people about their culture. I am assuming that all of you have a culture. Is there anybody here who doesn't have a culture? Everyone does; it's those things that you have carried around for generations. Maybe it seems they only come out on holidays. But some cultural attributes are so pervasive throughout a society that most people couldn't recognize them if their life depended on it. Take reading for example. Reading is a cultural attribute. It's been around for 8000 years or so on the Indo-European continent.

Think about today's topic, cultural impacts of fish advisories. What if you were asked to give up reading (obtaining and sharing information through written words and numbers)? How would your life be changed if this fundamental, cultural core attribute, were impacted? If it were taken away from you completely, it would be a disaster. Why else do we fight illiteracy at every turn? And even if you were only allowed some percentage during each day, it would probably still be a disaster. What would you choose to read? Would you choose to read your email or an Agatha Christie novel? Would you choose to use your word quota on tracking your retirement account status? Or would you waste your cultural word quota by reading the credits at the end of the show? Civilization as we know it today would be forever changed.

You may be thinking, "Choose something else besides reading. Reading is too ubiquitous in my life, too integral to our society and it's not realistic to think we could give up reading. If I gave up reading, I wouldn't be me. My profession communicates with written words and numbers, and my promotions and tenure are likely to be based on how much I publish. Without my profession, what would I be? How would our laws be taught? How would our ideals be expressed?"

Your reaction to this concept is exactly the same reaction I got when I asked my elders what if we were forced to give up eating our fish. Many of the reactions I got started with a shocked look, and then they demanded proof – who says these fish or those words can harm me? Why do I have to throw away this fish or burn these books? That is an example of a cultural impact of a fish advisory. Of course, it's "for the good of the people." But before you know it, people will be reading the comics and novels and going back their traditional ways of eating one or two pounds of fish per day. There's nothing like curling up in a chair on a rainy afternoon and eating smoked salmon with a good novel.

I have been told that there may be people in regulatory positions who think that people who don't comply with advisories are dumb, or uneducated, or deserve to get sick if there is a way to avoid the fish. I know that I will be blamed for not complying with an advisory. Some of you here today may think that people like me need to "get real" because this is a modern

chemical progressive world, and I'm trying to stand in the way of progress, and so I should hurry up and get assimilated into the good old American melting pot.

I need to explain that our fish and all of the supporting activities have been formulated for real reasons, survival reasons, a long time ago. I have been taught that I am part of an ancient oral tradition of cultural norms. The material or fabric of this tradition is unique, and is woven into a single tapestry that extends from far in the past, and long into the future. A risk from pollution that potentially affects one person of my community may have lasting impacts throughout all of the community, forever. In other words, a wave of risk can ripple outwards, affecting all of the individuals in our culture, just like a wave generated and propagated in a tapestry. You must remember, that if a culture dies, the only remnants are the material artifacts. In the event of the unthinkable happening, a continuously sustainable, natural resource based, material culture, such as the one my people and many other indigenous Tribal Nations embody, would rapidly disperse into the natural environment leaving no trace of our living cultures.

I recognize that the regulatory framework is fragmented by an accident of history. A problem was recognized a piece at a time and legislation was written to fix each piece as it was identified. But I cannot accept such a piecemeal approach. I and many like me are not going to change, not because we're being stubborn, uncooperative, or unreasonable, but because our ancestors have withstood a holocaust, termination policies, and religious persecution and I will not let them down.

I feel that advisories may be useful, but only as an unfortunate interim necessity. Responding to fish contamination is not just a communication problem. It is not a problem of communicating risk across a cultural divide. It is not just a matter of balancing risks and benefits. The problem is, we need to see EPA setting goals, taking action and standing firm to make things safe again. We need to see action in developing multi-media and watershed approaches to permitting. Trust responsibility is not a question of wall street profits verses children's health; it is a legal obligation.

The situation in the Columbia River at present is; that if a Tribal member fully exercised his or her treaty rights for long enough, given the amount of contamination in our fish now, it would probably be lethal. I don't want to have to scare people away from fish or their culture, but I must protect women and children and elders. Ultimately, we need to clean up the fish and the river, and we need to do it before any more cultural knowledge is lost.

To illustrate my point, here is an illustration I want to show you. [Figure 1; "Risk-Benefits or Loss-Harm"]. This slide depicts, on the left, the risk-benefit paradigm that most of you are familiar with. It assumes a 17.5 grams per day, a suburban fish ingestion rate. It assumes that people have the choice to eat more fish or no fish. In this case a person can balance the benefits to the heart from eating fish with the risks from the chemicals. For a suburban situation this method works. However, there are members of my family that traditionally eat 1000 grams per day (two and one half pounds per day). They and many of my people have done this for thousands and thousands of years. Today, this level of fish ingestion is generally precluded either through the loss of fisheries or through the high levels of contamination, so most of the fish benefits have already been lost. We have already lost most of the heart-protective benefits, and now have chemical risk. We have already lost the diabetes protection and the

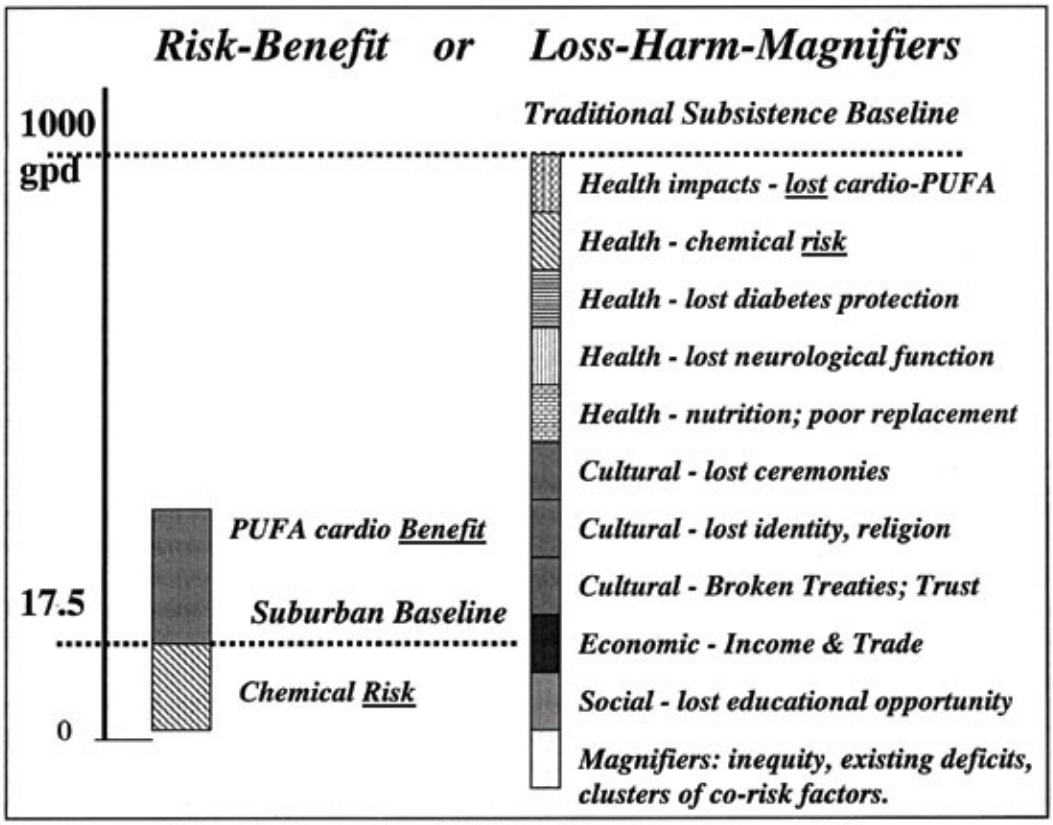


Figure 1. Comparison of risk benefit and loss-harm-magnifiers for traditional fish consumption.

neurological protection, both of which are well-documented benefits of eating fish. We have lost the nutrition, which is compounded by poor quality substitutes. Losing fish also means that we lose some of our ceremonies, our identity, and our religion. Our treaties have been broken once again. Also gone are commercial income from fishing and the fish used in trade networks. We are losing opportunities to educate our children and transfer the precious knowledge from one generation to the next. And finally there may be magnifiers of increased sensitivities, clusters of co-risk factors within tribal populations, disproportional impacts, and existing cultural deficits. This is why I think the conventional risk benefit paradigm is inappropriate for tribal situations and I would like to encourage the EPA to work with the Tribes on a Tribal method.

You must remember that we, the Tetokin, have been impacted through the encroachment of your society. Our tribal population has been affected by biological warfare, ecological warfare, economic warfare, and downright attempts at genocide. Yet, we have survived, with our culture intact even though we have been forced to endure this 600-year holocaust. The real history of our people is not being taught to you in school. Our struggle is not over. With each successive generation we are forced to react to numerous environmental, cultural, health, and

education impacts from members from your society who still perceive us a characters in a Hollywood movie.

My people have to deal with this complex set of problems, complete with numerous entrenched interests such as agribusiness, mining, and government, infrastructure development, and competing value sets vying for ever-decreasing resources. We use a logical process that includes education, law, analysis, research, and planning. Each of these processes is filtered and translated through our culture. Please note that the current EPA guidance for environmental justice fails to capture tribal concerns and does not deal fairly with the science of traditional environmental management. It does not adequately describe how to evaluate the distribution of risk between population groups such as tribes compared to suburbia. It completely omits evaluation of differences in impacts between the American society and my culture, and between different Tribal cultures and the resources on which those cultures depend. For example, I know that traditional tribal members with subsistence lifestyles will receive at least 2 to 100 times more exposure to a contaminant than a suburban resident might receive at identical environmental concentrations. I also know that my fellow tribal members typically have a larger burden of co-risk factors such as poor nutritional status, loss of natural diet, poorer access to health care, differences in metabolism, and so on. This means that tribal members might hypothetically not only receive more exposure, but might also be more sensitive, and have more obstacles to overcome in order to be healthy. Therefore, the cumulative impacts could be greatly magnified for tribal populations versus suburban populations.

Fish advisories are based on the best available science, and communicated to the public with the best socio-demographic profiling available. No stone is left unturned in attempts to enlighten us about making wise choices. Yet when you communicate your recommendations to Native Sovereign Nations such as mine, please remember that we too have logical, repeatable, verifiable, processes that I feel need to be taken into consideration up front, early in the decision making process.

To illustrate my point, I want to review the conventional scientific method because my tribal religion is based on an observational and applied science that has proved its worth over thousands of years through survival of my people. I want to briefly review the process for moving from observation, to hypothesis, to theory, to law. Tribal science has followed this path also.

Science is the observation, identification, description, experimental investigation, and theoretical explanation of phenomena. The scientific method is a general term for the lines of reasoning that scientists follow in attempting to explain natural phenomena. It typically includes observation, analysis, synthesis, classification, and inductive inference, in order to arrive at a hypothesis that seems to explain the phenomenon or solve the problem.

Remember that a hypothesis becomes theory if it withstands repeated testing and application. A hypothesis is a conception that is tentatively assumed, and then tested for validity by comparison with observed facts and by experimentation. A theory is a hypothesis that is supported to some extent by experimentation or factual evidence but that has not been so conclusively proven as to be generally accepted as law. Scientific law, such as the laws of physics, are so conclusively confirmed as to be inarguable.

Science is a product of the society that develops it, and the way that the theories and laws are expressed serve the needs of that society. American Indians have been observing natural phenomena, describing them, experimentally investigating them, and explaining natural phenomena and the natural resources for thousands of years. This tribal environmental knowledge forms the basis of traditional environmental management.

The reasoning that led to the determination of how to behave in the environment, based on what the environment consists of, is transferred to members of the tribe. Therefore, when a tribal member is gathering cultural materials, whether it is food or something else, he or she does it in a manner that reflects the principles of the science of traditional environmental management. This is the application of science, traditional tribal science, distilled into daily practice for the survival of a people.

The principles of traditional environmental management have been codified into law. There are some things you can do out in the environment and other things that you cannot do. The results of an action affect many things. The entropy of complex ecosystems is difficult to determine using "western" science, but the results of the most probable reactions have been observed by our elders and is related to us younger people through oral histories. Attention to the knowledge passed down means immediate survival and continuation of our people. Disregarding the knowledge can result in eating a poison, starvation or poor health. For countless generations our elders have told us about environmental conditions, and that our behavior is a product of rigorous and proven methodology that has guaranteed our survival through all types of natural cycles. Our lifestyle is resilient and has persisted through floods, droughts, cataclysms, upheavals, and warfare. We carry the unique and individual genes specifically adapted to and modified by our homelands.

Therefore, when I am asked, "What is cultural risk?" my answer is:

> "Because our people, the Tetokin, have been genetically modified by the ecology for thousands upon thousands of years, and have had their behavior modified as a result of responding to the flux of the ecology of our land for thousands upon thousands of years, and have produced a viable holistic environmental management system designed for continuously sustainable enhancement of our culture, and because the fabric of our very existence, including our sounds, medicine, science, art, music, and lifestyle is a reflection of thousands upon thousands of years of site-specific environmental shaping, any impact to those resources of which we are an inseparable part, is a risk to my culture."

I was asked by an educated man once, "How can a culture be irradiated?" He thought that only tangible things can be irradiated and therefore only tangible things can be at risk. He could not accept the notion of cultural risk. My answer is: "If my people are kept from a sacred site because that piece of mother earth has been contaminated, then I cannot transmit traditional teaching to future generations about the life significance of that site and therefore a significant part of my culture will be irreversibly altered."

How can you put a price on a sacred song that is derived from a landscape feature and is significant to the survival to my people and therefore my gene pool? Impacts to the ecology

directly impact the health of my people and put my culture at risk. Through time, my genetic characteristics may be adversely affected, thus destroying a multi-thousand year long fabric of blood. When an organism interacts and specializes within a finite set of environmental factors for thousands and thousands of years, that organism becomes the ecology. Within an ecological system all parts are important and all parts interact. Eventually the parts become mutually dependent, and neither part can be removed without harming or killing the whole.

When I asked the elders, they said to me, its true we have become the salmon and they have become us. We have lived and died for so long within the cycle of salmon that our flesh is one within the salmon people. We have lived here for more than ten thousand years eating salmon, deer, roots, and berries. The very molecules in our bodies have been passed back and forth between earth, plants, animals, and human beings. We have lived so long with our brothers and sisters that we have become one of them. We honor them every time we eat, setting our table just so. We pray for forgiveness from the Creator so the soul of the departed goes quietly into the land of light. We ask that their bodies nourish us and to make us strong. We cannot be separated from who we are. And we cannot forget the people who gave their lives for our children. Our lives, our voices, our thoughts, our bodies, are derived from these foods and water. No one can tell us anything different, because we know who we are, and where we came from. Our way of life and our culture are from our foods and the ancient knowledge of how they come to be with us, within us. When we contaminate the fish we contaminate ourselves and our children.

I want to close by asking you to remember that, no matter how narrowly your job description may be written, that water and fish are part of life. I challenge you to find ways to utilize your culture for the benefit of all our cultures. For when we've negotiated the best protective levels and developed fish-friendly infrastructure, all of our children, yours and mine, will thank us because what we do today lives on in history. Thank you.

Appendix M:
EPA Office of Water Brochures

FOR MORE INFORMATION

This is part of a series about how to enjoy fish safely. You can also read "Should I Eat the Fish I Catch?: A guide to healthy eating of the fish you catch" (available in several languages) to learn more about selecting fish from clean areas, choosing smaller fish, cleaning, and preparation. Call 1-800-490-9198 to order.

For more information about reducing your health risks from eating fish that contain chemical pollutants, contact your health or environmental protection department. You can find the telephone number in the blue section of your local telephone book.

You may also contact

U.S. Environmental Protection Agency
MS- 4305
1200 Pennsylvania NW
Washington DC 20460

On the World Wide Web see

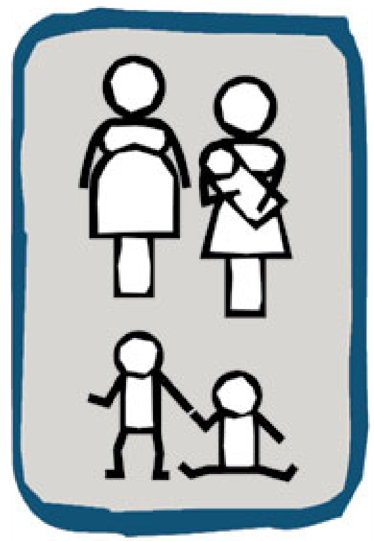
www.epa.gov/ost/fish

for information on fish advisories and links to all advisory programs and contacts

United States Environmental Protection Agency — EPA 823-F-01-012 — April 2001
Office of Science and Technology (4305)

EPA SHOULD I EAT THE FISH I CATCH?

A guide to healthy eating for women and children



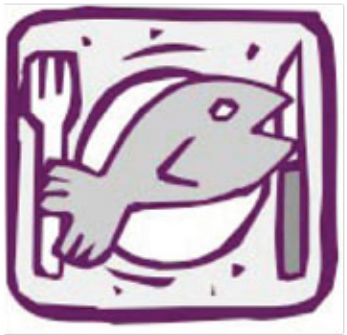
ATSDR *Developed in collaboration with the Agency for Toxic Substances and Disease Registry, U.S. Public Health Service*

INTRODUCTION

Fish can be an important part of a healthy diet. But, some fish have harmful amounts of mercury. Mercury consumed by a **pregnant or nursing woman, or a young child, can harm the developing brain and nervous system.**

You can get the benefits of fish and avoid the risks of mercury by following fish advisories. Contact your Health Department for advice about the fish caught and sold in your area. If there is no special advice for your area, follow the federal advice given here.

In 2001, the U.S. Environmental Protection Agency and the U.S. Food and Drug Administration issued national advisories concerning mercury in fish.



FRESHWATER FISH CAUGHT BY FAMILY AND FRIENDS

Contact your local Health Department for specific advisories for your area. If there are none, follow the federal advisories, below.

The U.S. Environmental Protection Agency (EPA) advises **pregnant women, women who may become pregnant, nursing mothers, and young children** to:

- ✓ limit their consumption of freshwater fish caught by family and friends to **one meal per week.**
  - for adults, one meal is 6 ounces of fish (cooked weight)
  - for children, one meal is 2 ounces
- ✓ for ocean fish caught by family and friends, use the advice for fish purchased in stores and restaurants.

see the next panel

FISH PURCHASED IN STORES AND RESTAURANTS

Contact your local Health Department for specific advisories for your area. If there are none, follow the federal advisories, below.

The U.S. Food and Drug Administration (FDA) advises **pregnant women, women who may become pregnant, nursing mothers, and young children** to:

- ✓ **not eat shark, swordfish, king mackerel, and tilefish**

Women who are or may become pregnant:

- ✓ can safely eat an average of **12 ounces per week** (cooked weight) of other types of fish
  - choose a variety from shell fish, canned fish, smaller ocean fish, and farm-raised fish
  - fish purchased in stores and restaurants usually have less mercury than freshwater fish caught by family and friends, so you can safely eat more.

Introduction

Fish are an important part of a healthy diet. They are a lean, low-calorie source of protein. Some sport fish caught in the nation's lakes, rivers, oceans, and estuaries, however, may contain chemicals that could pose health risks if these fish are eaten in large amounts.

The purpose of this brochure is not to discourage you from eating fish. It is intended as a guide to help you select and prepare fish that are low in chemical pollutants. By following these recommendations, you and your family can continue to enjoy the benefits of eating fish.

Fish taken from polluted waters might be hazardous to your health. Eating fish containing chemical pollutants may cause birth defects, liver damage, cancer, and other serious health problems.

Chemical pollutants in water come from many sources. They come from factories and sewage treatment plants that you can easily see. They also come from sources that you can't easily see, like chemical spills or runoff from city streets and farm fields. Pollutants are also carried long distances in the air.

Fish may be exposed to chemical pollutants in the water, and the food they eat. They may take up some of the pollutants into their bodies. The pollutants are found in the skin, fat, internal organs, and sometimes muscle tissue of the fish.

What can I do to reduce my health risks from eating fish containing chemical pollutants ?

Following these steps can reduce your health risks from eating fish containing chemical pollutants. The rest of the brochure explains these recommendations in more detail.

1. ***Call your local or state environmental health department.*** Contact them before you fish to see if any advisories are posted in areas where you want to fish.
2. ***Select certain kinds and sizes of fish for eating.*** Younger fish contain fewer pollutants than older, larger fish. Panfish feed on insects and are less likely to build up pollutants.
3. ***Clean and cook your fish properly.*** Proper cleaning and cooking techniques may reduce the levels of some chemical pollutants in the fish.

Health Note

Advisories are different from fishing restrictions or bans or limits. Advisories are issued to provide ***recommendations*** for limiting the amount of fish to be eaten due to levels of pollutants in the fish.

A Message from the Administrator

Christine Todd Whitman

I believe water is the biggest environmental issue we face in the 21st Century in terms of both quality and quantity. In the 30 years since its passage, the Clean Water Act has dramatically increased the number of waterways that are once again safe for fishing and swimming. Despite this great progress in reducing water pollution, many of the nation's waters still do not meet water quality goals. I challenge you to join with me to finish the business of restoring and protecting our nation's waters for present and future generations.

For More Information

For more information about reducing your health risks from eating fish that contain chemical pollutants, contact your local or state health or environmental protection department. You can find the telephone number in the blue section of your local telephone directory.

You may also contact:

U.S. Environmental Protection Agency
Office of Water
Fish and Wildlife Contamination Program (4305T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

web address: www.epa.gov/ost/fish

United States Environmental Protection Agency
Office of Water (4401M)
EPA 823-F-02-005 • April 2002

In celebration of the 30th anniversary of the Clean Water Act, EPA presents

A Guide to Healthy Eating of the Fish You Catch

★ 2002 ★
THE YEAR OF CLEAN WATER
Celebrating a Commitment

ATSDR

Developed in collaboration with the Agency for Toxic Substances and Disease Registry, U.S. Public Health Service

Catching Fish

How can I find out if the waters that I fish in are polluted?

It's almost impossible to tell if a water body is polluted simply by looking at it. However, there are ways to find out.

First, look to see if warning signs are posted along the water's edge. If there are signs, follow the advice printed on them.

Second, even if you don't see warning signs, call your local or state health or environmental protection department and ask for their advice. Ask them if there are any advisories on the kinds or sizes of fish that may be eaten from the waters where you plan to fish. You can also ask about fishing advisories at local sporting goods or bait shops where fishing licenses are sold.

If the water body has not been tested, follow these guidelines to reduce your health risks from eating fish that might contain small amounts of chemical pollutants.

Health Note

Some chemical pollutants, such as mercury and PCBs, can pose greater risks to women of childbearing age, pregnant women, nursing mothers, and young children. This group should be especially careful to greatly reduce or avoid eating fish caught from polluted waters.

Do some fish contain more pollutants than others?

Yes. You can't look at fish and tell if they contain chemical pollutants. The only way to tell if fish contain harmful levels of chemical pollutants is to have them tested in a laboratory. Follow these simple guidelines to lower the risk to your family:

- If you eat gamefish, such as lake trout, salmon, walleye, and bass, eat the smaller, younger fish (within legal limits). They are less likely to contain harmful levels of pollutants than larger, older fish.
- Eat panfish, such as bluegill, perch, stream trout, and smelt. They feed on insects and other aquatic life and are less likely to contain high levels of harmful pollutants.
- Eat fewer fatty fish, such as lake trout, or fish that feed on the bottoms of lakes and streams such as catfish and carp. These fish are more likely to contain higher levels of chemical pollutants.

Cleaning Fish

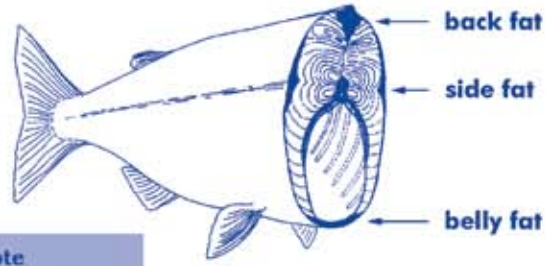
Can I clean my fish to reduce the amount of chemical pollutants that might be present?

Yes. It's always a good idea to remove the skin, fat, and internal organs (where harmful pollutants are most likely to accumulate) before you cook the fish.

As an added precaution:

- Remove and throw away the head, guts, kidneys, and the liver.

Trim away the skin and fatty tissue before cooking to reduce the level of some pollutants in the fish you eat.



Health Note

Mercury is found throughout the tissue in fish, so these cleaning and cooking techniques will not reduce the amount of mercury in a meal of fish.

- Fillet fish and cut away the fat and skin before you cook it.
- Clean and dress fish as soon as possible.

Remember that with any fresh meat, always follow proper food handling and storage techniques. To prevent the growth of bacteria or viruses, keep freshly caught fish on ice and out of direct sunlight.

Cooking Fish

Can I cook my fish to reduce my health risk from eating fish containing chemical pollutants?

Yes. The way you cook fish can make a difference in the kinds and amounts of chemical pollutants remaining in the fish. Fish should be properly prepared and grilled, baked, or broiled. By letting the fat drain away, you can remove pollutants stored in the fatty parts of the fish. Added precautions include:

- Avoid or reduce the amount of fish drippings or broth that you use to flavor the meal. These drippings may contain higher levels of pollutants.
- Eat less fried or deep fat-fried fish because frying seals any chemical pollutants that might be in the fish's fat into the portion that you will eat.
- If you like smoked fish, it is best to fillet the fish and remove the skin before the fish is smoked.

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