

Fish Contamination: *Environment and Health at Risk*

*Holly Brown-Williams,
Joan Lichterman,
Sherri Norris,
and James VanDerslice*

For Jim Brown and his Elem Pomo tribe, living by Clear Lake, California, fish was a staple, and fishing with nets and traps was an important link to their culture—one of the oldest in America.

However, Jim says, “We completely stopped fishing in the 1970s, when we learned that the fish were contaminated.” The source of the contamination was the nearby Sulphur Bank Mercury Mine, now an EPA Superfund site. Concerns like this, about mercury, pesticides, and other contaminants, are disrupting the dietary and cultural traditions of the Elem Pomo and many other communities that have relied on fish for food. In Jim Brown’s words, “We don’t eat any fish out of the lake any more.”



This painting by Denise Davis of the Mountain Maidu (Plumas County, California) illustrates the disruption of Native lands and traditions.

A Growing Problem

Water pollution and fish contamination are acute and chronic public health hazards, even in remote maritime populations—with potentially devastating ecological and human health consequences. “Globally, over one billion people rely on fish and other seafood as their main source of animal proteins,” state Éric Dewailly and Anthony Knap, “and many small island states depend on fish exclusively, particularly native peoples.”

Dewailly and Knap are researchers who specialize in the impact of ocean contaminants on human health. They say that methylmercury and persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs), dioxin, and chlorinated pesticides “potentially threaten human health, particularly that of the developing human fetus and infant.” Effects of POPs include “developmental, immune, and/or cognitive deficits in newborns,” some lasting into later childhood. In addition, some of these contaminants affect the central nervous system, the reproductive system, and the liver, and can cause cancer.

Mercury is a contaminant of particular concern. It can cause developmental problems in children; it impairs learning ability, language skills, attention, and memory. It can harm the fetus during pregnancy (although the mother often has no symptoms). Concern about the effects of mercury and other contaminants has led many health agencies to issue fish consumption advisories on which fish to eat, from which sources, in what quantities, and how often.

Toxic chemicals in oceans, bays, rivers, and lakes affect our water resources, the health and survival of the fish we eat, and ultimately our personal health and our economies.



Contaminants have no jurisdictional boundaries.

Fish Contamination Has Widespread Effects

As contaminants enter ecosystems, there are unforeseen effects. For example, nearly all fish and shellfish contain traces of mercury, which becomes more toxic as it enters water and is transformed into methylmercury by bacteria and microorganisms in the sediments. Many pollutants, like mercury, build up and remain in fish tissues, and concentrate at higher levels in the fish, birds, and other animals that eat them. These phenomena—called bioaccumulation and biomagnification—are the primary reasons for high levels of contaminants in fish, particularly those that are high in the food chain.

Virtually all waterbodies are affected. The U.S. Environmental Protection Agency reports that mercury contamination is extremely widespread. Environment Canada calls the Great Lakes a chemical hotspot. More than 360 chemical compounds have been identified, many of them persistent and toxic. They are already devastating the ecosystem. Many fish species have tumors, tissue

damage, and decreased reproductive capacities. “Of the 10 most highly valued species of fish in Lake Ontario, seven have now almost totally vanished.” Birds and mammals that eat fish are also declining.

Fish contamination and extinction will increasingly affect our economies. The California Fisheries Coalition estimates that recreational and commercial fishing industries contributed \$5.5 billion to the state’s economy in 2005. Washington State’s Department of Ecology reported in 2006 that the Puget Sound region drives \$20 billion in economic activities, primarily through fishing, boating and other forms of recreation, tourism, and jobs and trade associated with ports.

Benefits of Eating Fish

Scientists are continuing to debate the benefits and risks of eating potentially contaminated seafood. Evidence has been mounting on both sides of the debate, which makes it both necessary and difficult to advise the public.

A 2007 Institute of Medicine study reports that fish are a source of high-quality protein that is low in saturated fat and rich in many micronutrients. Overwhelming scientific evidence shows that omega-3 fatty acids found in fish or supplements are good for the heart and protect against inflammatory diseases. They promote healthy neurodevelopment in children. When consumed by pregnant and lactating women, they benefit fetal and child development.

Consumers face a dilemma. They are told that seafood is good for them and should be consumed regularly, yet are cautioned against consuming certain species or seafood from specific waters because of contaminants.

Sources of Fish Contamination in Sediment and Water

- “Legacy” contaminants (mercury, arsenic, and asbestos from mines, and outlawed pesticides and compounds like DDT and PCBs that don’t degrade quickly, if at all)
- Polluted water runoff from agricultural and urban centers
- Toxic byproducts of agricultural, oil refining, shipping, manufacturing, and other industrial processes (released into the air, the waterways, or the ground)
- Burning of fossil fuels and other materials
- Improper disposal of pharmaceuticals and products containing mercury or other toxics
- “Emerging” pollutants (beginning to be recognized as hazardous: bromine- and chlorine-based flame retardants, fluorine-based stain repellants)

Cambodians have found a connection to the old ways in Stockton, California. Guided by thousands of years of traditional fishing on the Mekong Delta, Cambodian fishers look for identity and nourishment in the waters of the Sacramento-San Joaquin River Delta. But the Central Valley's history of mining, agriculture, industry and huge water-diversion projects has made fishing a risky proposition.

—Jeremy Miller



Getty Images News/Getty Images

Public health officials struggle to provide the right advice for at-risk populations. For example, a survey of low-income women in Stockton, California conducted by Elana Silver and others for the California Department of Public Health showed that nearly one in three women exceeded fish consumption advisory limits. If these women are told not to eat fish, what will they eat?

Challenges Ahead

Fish and waterbody contamination remain unresolved despite public concern about the relationship between health and the environment. The following challenges highlight the scope of the problem in California and Washington. Other states have their own unique challenges and solutions.

- **Fish contamination is an environmental justice issue.** Fishing is an important economic and cultural activity in some ethnic communities. As a result, these groups consume large amounts of fish and have higher exposure to chemicals. Yet, they often have no say in the decisions made by the government and business interests that affect water policies in their communities.

- **Advisories have limited reach.** Elana Silver and others found that only 48% of those sampled in the California Women's Health Survey were aware of health warnings about eating fish. People who don't speak English, or have low levels of income or education, tend to have low awareness of advisories. Written materials are rarely the best way to reach limited-English-speaking populations. Some community-based organizations and California agencies are using radio, cable TV, and community events and trainings to reach people more effectively.
- **Information for the public is inconsistent and confusing.** Different messages from different sources, such as government advisories, food guides, and news media, confuse consumers—who often don't know which to believe.
- **Historically, monitoring efforts have not addressed public health issues.** Waterbody contamination generally has been seen as a natural resources rather than a public health problem. As a result, fish contamination and consumer protection have not been a major focus of state efforts to assess waterbodies and monitoring was not designed to provide the kind of data needed to develop fish consumption guidelines.

Consumers of Sport Fish by Ethnicity

Percent of all women surveyed who ate sport fish	
White	30%
African American	25%
Hispanic	19%
Cambodian	75%
Vietnamese	58%
Hmong	86%
Filipino	57%
Other Asian/PI	65%
Native American	55%

The proportion of low-income Stockton women, by ethnic group, who reported that they ate sport fish (caught by themselves, family, or friends). *Silver et al., 2007.*

Key Actions to Address Fish Contamination in California

- Set statewide standards for data collection to facilitate sharing of data.
- Create formal partnerships to foster collaboration, overcome turf issues, and ensure stakeholder involvement.
- Increase funding to monitor for contaminants and assess health risks.
- Develop a variety of consumer advisory outreach methods.
- Establish consistent policies regarding the interpretation of scientific information.
- Make better use of data to drive improved policies.
- Increase transparency in government actions.
- Collect better information about what people are actually consuming.
- Share information and best practices, raise awareness, and promote statewide action on fish contamination.

(HRA survey, 2007)

- **Policies and funds are inadequate to address fish contamination.** A variety of federal, state, county, local, and tribal authorities monitor contamination, regulate sources, and educate the public. However, each entity can focus on only part of the problem because of restrictions in legal jurisdiction. Even when mandates exist, lack of funding makes it difficult to do effective monitoring or outreach. Scarcity leads to piecemeal efforts and rivalries, hindering interagency strategic planning. In addition, funds are often site-specific, short-term, and nonrenewable—forcing agencies to focus narrowly on the most immediate and pressing obligations.
- **The prevalence of fish contamination is unknown.** Cal/EPA's Office of Environmental Health Hazard Assessment has issued more than 2 dozen advisories for inland waterbodies, but many watersheds and fish populations remain untested. Washington has 650 bodies of water in 39 counties, and advisories exist primarily for the most commonly fished areas.
- **Local models have not been adapted at state levels.** In California to date, little effort has gone into creating statewide strategies or action plans with broad stakeholder input or involvement. The Fish Mercury Project in the Sacramento-San Joaquin Delta watershed is a collaboration between three state agencies and many stakeholder groups. It has been highly successful, but concerns only one watershed and is time-limited. Its success has not been translated into a statewide plan. Stakeholders are involved in Washington's Puget Sound Partnership and in a few other places, but no comparable statewide activities exist.

2-3 MEALS PER WEEK FROM THIS LIST (HEALTHY CHOICE: 1 MEAL A WEEK)

OR

1 MEAL PER WEEK FROM THIS LIST (HEALTHY CHOICE: 1 MEAL A WEEK)

AVOID (EAT RARELY, IF AT ALL)

Follow these guidelines to reduce exposure to mercury, PCBs, and other contaminants:

Anchovies	Salmon (fresh, canned; Chinook (coastal, Alaska)	Black sea bass	Mahi mahi
Butterfish (Silver pomfret)	Chum	Chilean sea bass	Monkfish
Catfish	Coho	Chinook salmon (Puget Sound)	Rockfish/Red snapper (trawl caught)
Clams	Farmed (Atlantic) *	Croaker (white, Pacific)	Sablefish
Cod (Pacific) (Atlantic)	Pink	Halibut (Pacific) (Atlantic)	Tuna (canned white Albacore) (WA, OR, CA troll caught)
Crab (blue, king, snow, (US, Canada) (Russia)	Sockeye	Lobster (US, Canada)	
Crab-Limitation	Sardines		
Crayfish	Scallops		
Flounder/Sole (Pacific) (Atlantic)	Shrimp (US) (Imported)		
Herring	Squid/Calamari		
Mackerel (canned)	Tilapia (US, Central America) (China, Taiwan)		
Oysters	Trout		
Pollock/Fish sticks	Tuna (canned light)		

Fish Not On the List? Call DOH toll free at 1-877-485-7316 for information.

* Farmed Salmon health and environmental impacts are controversial. For more information, visit www.doh.wa.gov/fish/farmedsalmon.

Women who are or may become PREGNANT, NURSING MOTHERS, and CHILDREN should NOT eat these fish:

Mackerel (king)	Swordfish
Marlin	Tilefish
Shark	Tuna steak

Adult Meal Size = 8 oz. UNCOOKED
Child Meal Size = 4 oz. UNCOOKED

A seafood meal appropriate for your body size is about the size and thickness of your hand.

Figures based on a 160 lb. adult and an 80 lb. child. To personalize a meal size, add or subtract 1 oz. for every 20 lb. difference in body weight.

ORANGE TEXT indicates seafood choices that are over-fished or are harvested in environmentally harmful ways.

One of Washington's eating guides, which can be folded to fit in a wallet.

People Want and Support Action

State and national surveys have repeatedly shown that most people are concerned about the relationship between their health and the environment. For example, a public opinion survey conducted by the Washington Department of Ecology revealed that 97% of Puget Sound residents believe a healthy Puget Sound is a legacy that we must leave to our children and grandchildren. In a Pew Charitable Trusts survey of California voters, 9 in 10 said that federal, state, and local governments should give important or top priority to reducing the number of illnesses caused by environmental problems. National polls also show overwhelming support for protecting the environment.

UC Berkeley's Health Research for Action (HRA) surveyed California community, environmental, advocacy, and tribal organizations, and state and regional agencies, to learn about their activities and collaborations to address fish contamination, their successes and failures, and their next steps. Interviewees strongly supported the development of a statewide plan to effectively address fish contamination.

Prescription for Change

Statewide coordination of policy, monitoring, prevention, cleanup, and public outreach are essential to protecting public health and the environment, starting with the following steps:

- 1. Increase public awareness of the benefits and risks of eating fish.** Greater and more coordinated efforts are needed to educate people about the health benefits of eating fish, as well as the need to choose fish that are low in contaminants. Effectively communicating two messages at once—benefits and risks—is just one of many challenges.

These efforts need to reach audiences diverse in culture and language. In California, community-based groups such as Todos Unidos, United Cambodian Families, and the California Indian Environmental Alliance attempt to distill complex advice into clear and culturally relevant information.

Successful models should be expanded. In Washington, the state Department of Health

collaborated with Thurston County Public Health and grocers to develop the Healthy Fish Choices Grocery Store Project. The project helps shoppers choose fish with fewer contaminants. Social marketing strategies include putting stickers on packages to highlight healthy fish choices, and distributing attractive, take-home wallet cards with clear eating guidelines about different species and how they are harvested. Anecdotal evidence shows that better-informed consumers have been buying more fish.

California's pilot Fish Mercury Project resulted in clearer sport fish advisories from the Office of Environmental Health Hazard Assessment. Interviews and focus groups with consumers and meetings with community organizations helped the agency determine which fish locations and species to test, and how to communicate advisories more effectively. For example, many women didn't relate to the phrase "women of child-bearing age," but understood messages addressed to "women ages 18–45."



Healthy Fish Choices Grocery Store Project

Eat Fish.
Be Smart. Choose Wisely.



Package B

- 1 Symbol Alert:** self-cling decal for display case (6 x 6") and/or wall mount sign on gatorboard (6 x 6")
- 2 Ice Picks:** plastic picks (4" h) with Healthy Choice symbol for fish displays
- 3 Healthy Fish Choices List:** self-cling decal for display case (8.5 x 11") and/or wall mount sign on gatorboard (8.5 x 11")
- 4 Recipe Cards:** (6" w x 4" h); and suction-cup mounted acrylic holder
- 5 Healthy Fish Choices Guides:** (6" w x 4" h); and suction-cup mounted acrylic holder

Package B of the Point of Sale packages in the Healthy Fish Choices Grocery Store Project. Other packages (not shown) are available as well.

Washington's Healthy Fish Choices Grocery Store Project was developed by Liz Carr and Dave McBride of the Department of Health (DOH), and Rachel Laderman of the Thurston County Public Health and Social Services Department; graphics were developed by Barbara McConkey, Inform Design. Agencies in other states are welcome to tailor and distribute project materials to meet their needs. For more information, contact Liz or Dave at the DOH. Phone: 1-877-485-7316; e-mail: Liz.Carr@doh.wa.gov, Dave.McBride@doh.wa.gov.



Kendra Luck

Fishing along the bank of the San Joaquin River in Stockton, where it is clearly posted that the fish are contaminated with high levels of mercury.

2. Develop comprehensive statewide action plans. State planning and policy coordination are necessary to address the sources of fish and water contamination, ensure comprehensive monitoring, and develop effective pollution prevention and cleanup strategies.

Statewide coordination can solve many problems that agencies and jurisdictions currently face. State plans can increase the visibility of problems, and develop and promote effective solutions. They can provide standards for data collection and sharing, and a framework for accountability. And

they can enable evaluation and dissemination of effective education strategies.

3. Involve stakeholders. State plans need to allow for local and regional innovation and action. They must be developed with stakeholders representing regional, state, and federal governmental agencies, tribes, and community-based, scientific, private, and public-interest organizations. Coordination, consensus-building, and transparency are critical.

4. Incorporate public health into protection of ecosystems and water quality. Programs that focus on ecosystem protection and restoration need to be expanded to address the public health dimensions of environmental problems and potential solutions.

For example, in California the Water Quality Monitoring Council's mandate should be broadened to include all waterbodies and any

fish species that is consumed by the public—not just a few indicator species—to enable development of comprehensive fish advisories. The Surface Water Ambient Monitoring Program monitors pollution, but is not mandated or funded to develop comprehensive fish advisories. The California Ocean Protection Council is mandated to protect and conserve coastal waters and ocean ecosystems. Its scope should be expanded to address the public health impacts of environmental contamination and to consider watersheds reaching inland.

5. Strengthen enforcement mechanisms where protective laws exist. California's Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) requires notifying the public about the presence of toxic chemicals known to cause cancer or birth defects. Enforcement, however, requires suing "in the public interest," on the grounds that a business knowingly and intentionally exposed an individual to one of these chemicals without providing a clear and reasonable warning. City and county public health departments need additional resources to work with supermarkets and restaurant owners to help them understand the health risks of eating contaminated fish and comply with the law.

6. Promote public demand for safer and sustainably harvested fish. Better information about fish sources and quality will promote consumer actions. Actions such as asking grocers and restaurants where their fish are from can help discourage the catching and selling of fish that are endangered or nonecologically farmed. Washington's Healthy Fish Choices Grocery Store Project is an effective model for responding to the public's need for reliable information.

Conclusion

Contaminated ecosystems have an increasing impact on human health. Monitoring and publicizing this impact advances efforts to protect the environment. To date, major efforts to improve coastal and marine environments have not extended to inland waterways or focused on threats to human health. Disparate federal, state, and regional programs have responsibilities for fish and waterbody contamination. However, the complexity of the problem and of the regulatory frameworks, as well as decentralized responsibility, impede the coordinated action that is essential for effective pollution prevention, assessment, or cleanup and public education.

Water pollution and fish contamination remain significant problems and pose disproportionate risks to some populations, which must be involved in efforts to address these problems. Policymakers need to make fish contamination a priority, and coordinated statewide action is essential to addressing these problems regionally and nationally.

References

- California Fisheries Coalition (2005). Estimated Economic Value of CFC Membership, May 15. Sacramento.
- Dewailly E, Knap A (2006). "Food from the oceans and human health: Balancing risks and benefits." *Oceanography* 19(2): 84–93, June.
- Environment Canada. The Management of Water; Water Pollution; The Great Lakes: Chemical Hotspot. Accessed at http://www.ec.gc.ca/water/en/manage/poll/e_hotspot.htm.
- Institute of Medicine (2007). Nesheim MC, Yaktine AL (eds.). *Seafood Choices: Balancing Benefits and Risks*. Washington, D.C.: National Academies Press.
- Miller J (2007). "Traucherous catch: Choosing between the health of Stockton's Cambodian families and the survival of their subsistence culture." *San Francisco Chronicle Magazine*, October 28.
- Princeton Survey Research Associates (2000). Report on the Findings: National Survey of Public Perceptions of Environmental Health Risks, California Component. July. Accessed at <http://healthyamericans.org/reports/files/casurvey0717.pdf>.
- San Francisco Estuary Institute (SFEI, 2007). *The Pulse of the Estuary: Monitoring and Managing Water Quality in the San Francisco Estuary*. SFEI Contribution 532. Oakland, Calif.: San Francisco Estuary Institute.
- Silver E, Ujihara A, Lee D, Smith D. Fish consumption patterns and advisory awareness among California women. Manuscript to be submitted to *Environmental Research*.
- Silver E, Kaslow J, Lee D, Lee S, Tan M, Weis E, Ujihara A (2007). Fish consumption and advisory awareness among low-income women in California's Sacramento-San Joaquin Delta. *Environmental Research* 104(3): 410–419.
- U.S. Environmental Protection Agency (2008). What You Need to Know About Mercury in Fish and Shellfish. Accessed at <http://www.epa.gov/waterscience/fish/advice/>. Updated July 24.
- U.S. Environmental Protection Agency (2007). Habitat Protection, Challenges Facing Our Estuaries. Accessed at <http://www.epa.gov/owow/estuaries/pivot/overview/cf.htm>. Updated October 30.
- Washington Department of Ecology (2007). Puget Sound: Protecting and Restoring a National Treasure. Ecology Pub #07-01-005, June. Olympia.
- Washington Department of Ecology (2006). The Puget Sound Economy. Ecology Pub 06-01-006, May 30. Olympia.

About the Authors

Holly Brown-Williams is Director of Policy and Joan Lichterman is Managing Editor of *Perspectives* at Health Research for Action, University of California, Berkeley. Sherri Norris is Executive Director of the California Indian Environmental Alliance. James VanDerslice is an Associate Professor of Public Health at the University of Utah, and was formerly Senior Epidemiologist in the Office of Environmental Health Assessments, Washington State Department of Health.

Technical Reviewers

The authors have benefited from reviews of technical content by Richard Kreutzer, Chief, Division of Environmental and Occupational Disease Control, and Alyce Ujihara, Research Scientist, Environmental Health Investigations Branch, in the California Department of Public Health.

To Learn More

- California Indian Environmental Alliance:**
<http://cieaweb.org/>
- Environmental Health Investigations Branch, California Department of Public Health:**
<http://ehib.org/>
- Office of Environmental Health Hazard Assessment, Cal/EPA, Fish:**
<http://oehha.ca.gov/fish.html>
- Washington State Department of Health, Fish Facts:**
<http://www.doh.wa.gov/ehp/oehas/fish/>
- U.S. Environmental Protection Agency, Water Science:**
<http://epa.gov/waterscience/>
- Great Lakes Binational Toxics Strategy:**
<http://epa.gov/glnpo/p2/bns.html>
- San Francisco Estuary Institute, Fish Mercury Project:**
<http://sfei.org/cmrfishmercury/>

About Health Research for Action

Health Research for Action is located in the UC Berkeley School of Public Health. Our mission is to conduct research and translate findings from that research into policies, resources, and programs that reduce health disparities and create healthier, more empowered communities. All of our work is conducted in partnership with the people living in these communities.

To Contact Us

Health Research for Action
School of Public Health
University of California, Berkeley
2140 Shattuck Avenue, 10th Floor
Berkeley, CA 94704-7388
PHONE: 510.643.9543
FAX: 510.642.9792
TTY: 510.643.4451
EMAIL: healthaction@berkeley.edu
WEB: www.healthresearchforaction.org

