



*A Quick Reference Guide  
for Clinicians®*

## Fish Consumption to Promote Good Health and Minimize Contaminants

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## Clinical Advisory Committee

### **Andrew Helfgott, MD**

Director, Maternal Fetal Medicine  
Sacred Heart Women's Hospital  
Pensacola, FL

### **Lillie Rizack, CNM, MSN**

Midwife, Chestnut Hill Hospital  
Faculty, The Midwifery Institute of Philadelphia University  
Philadelphia, PA

### **Anne Robin, MD**

Clinical Assistant Professor, Family Medicine  
University of Illinois at Urbana-Champaign  
Champaign, IL

### **Katherine M. Shea, MD, MPH, chair**

Consultant, Physicians for Social Responsibility  
Adjunct Faculty, Duke University Medical Center  
Chapel Hill, NC

### **William B. Weil, MD**

Professor Emeritus, Department of Pediatrics and Human Development  
Michigan State University, College of Human Medicine  
East Lansing, MI

## Contributing Staff /Consultants

Rivka Gordon, PA-C, MHS  
Director of Strategic Initiatives, ARHP

Beth Jordan, MD  
Medical Director, ARHP

Katherine Lacy, MA, RN  
Consulting Writer

Nancy Monson  
Consulting Writer

Wayne Shields  
President and CEO, ARHP

Amy Swann, MA  
Director of Education, ARHP

Kristen Welker-Hood  
Environment & Health Program Director, PSR

## Introduction

The health benefits of fish and seafood have been well documented and widely promoted in recent years. Fish is low in saturated fat, a good source of high-quality protein, and a healthy alternative to red meat.<sup>1</sup> It provides the body with essential vitamins and minerals, including iron, zinc (from shellfish), and vitamins A, B, and D. Omega-3 fatty acids found in fish such as salmon, rainbow trout, sardines, oysters, and sole are also beneficial, particularly in terms of cardiovascular health. Preliminary evidence suggests that early exposure to omega-3 fats may enhance brain development as well.<sup>2-8</sup>

At the same time, fish are vulnerable to contamination by toxic industrial pollutants, such as mercury, as well as polychlorinated biphenyls (PCBs), dioxins, flame retardants, and other lipophilic chemicals.<sup>1</sup> These pollutants accumulate in fish flesh (mercury) or fatty tissue (PCBs), exposing people who eat them.

Health care providers are confronted with the need to offer useful dietary guidance to patients in the presence of these conflicting recommendations about the risks and benefits of consuming fish and seafood. This *Quick Reference Guide*, developed jointly by the Association of Reproductive Health Professionals (ARHP) and Physicians for Social Responsibility (PSR), reviews the scientific evidence on toxic fish contaminants and offers guidelines to assist clinicians in communicating with patients about the risks and benefits of eating fish. The guidelines also provide concrete suggestions for day-to-day consumption of fish and other seafood. Our recommendations rely mostly on the seafood choices guidelines released by the Institute of Medicine (IOM) in 2006, but also take into account the recommendations issued jointly by the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA)<sup>8</sup> in 2004 on mercury levels in fish and shellfish.<sup>1,9</sup> The ARHP/PSR guidelines also address the health risks posed by lipophilic contaminants, such as PCBs.

Developing fetuses are particularly vulnerable to common fish contaminants, and infants and children remain vulnerable due to rapid brain growth and development. The guidelines provided here are most important for pregnant and breastfeeding women and for young children. Because these pollutants build up in the body over

time, a woman's dietary habits throughout her early life can influence the exposures of her future children.<sup>10</sup> A woman who is contemplating pregnancy in the future can lower her blood mercury level by careful eating for 6 to 12 months before becoming pregnant, but PCBs accumulate over time, and lifelong vigilance is required to minimize maternal body burden. All women of childbearing age—even adolescent girls—should follow the recommendations summarized at the end of this *Quick Reference Guide*. It is also important to acknowledge that there is limited data on which to base recommendations, these guidelines should be viewed as provisional and subject to revision as more is learned or as effective measures are taken to eliminate toxic pollutants from our environment.

## Scientific Evidence on Fish Contaminants

Mercury and persistent organic pollutants (POPs) such as PCBs are common contaminants of freshwater as well as ocean fish. These pollutants have been released to the environment in large quantities by industrial activities, and fish from more than half of inland lakes and rivers in the United States contain detectable levels of these or other chemicals. Many are contaminated at or near levels of concern. These contaminants can travel beyond national borders, persist for long periods in the global environment, and accumulate to toxic levels in aquatic ecosystems and fish. Many are potent neurotoxicants, and the developing brains of fetuses, infants, and young children are most sensitive to the effects of exposure. When these pollutants are ingested, their concentrations build up in the body over time. As a result, past as well as current dietary habits influence the body burden of these contaminants, particularly in the case of POPs.

**Mercury.** Mercury is a persistent heavy metal that occurs in elemental form as well as various organic and inorganic forms.<sup>11</sup> Most of the human-caused mercury pollution in our environment is emitted from industrial smokestacks.<sup>12</sup> The EPA has concluded that coal-fired power plants are the nation's largest source of unregulated mercury emissions attributable to human activity. Other major sources include mining, smelting, and waste incineration.<sup>13</sup>

Mercury that is released into the atmosphere from various industrial activities can be deposited onto soil or into waterways.<sup>14</sup> Biological processes then convert it to organic forms, such as methylmercury, which bio-accumulates through the food chain. Consequently, mercury concentrations are highest in large, long-lived predatory fish. In 2006, mercury contamination led 48 states to issue 3,080 fish consumption advisories for rivers, lakes, and coastal areas.<sup>15</sup>

**Table 1** shows the mean mercury levels measured in various species of fish and shellfish, as determined by the EPA and FDA from a variety of data sources.<sup>16</sup> In the absence of a single "official" standard, ARHP and PSR selected the breakpoints between lower, moderate, and highest mercury levels that are used to categorize the species in the chart.

Methylmercury readily crosses the placenta and enters the fetal brain, where it impairs normal development. Epidemiological studies suggest that prenatal exposure to even low levels of mercury may

Table 1. Mercury Levels in Commercial Fish and Shellfish

SPECIES	MEAN MERCURY LEVEL (parts per million [ppm])
<b>Lower Mean Mercury Levels (None detected [ND] to 0.29 ppm)</b>	
Bass (saltwater; includes sea bass/striped bass/rockfish)	0.22
Catfish	0.05
Clams <sup>a,d</sup>	ND
Cod <sup>b</sup>	0.10
Crab (blue, king, and snow) <sup>d</sup>	0.06
Crawfish	0.03
Flatfish (includes flounder and sole) <sup>d</sup>	0.05
Haddock	0.03
Halibut <sup>d</sup>	0.25
Herring <sup>c</sup>	0.04
Lobster (spiny)	0.09
Mackerel chub (Pacific) <sup>d</sup>	0.08
Mackerel chub (South Australia) <sup>d</sup>	0.09
Mackerel, Spanish (South Atlantic) <sup>d</sup>	0.18
Monkfish <sup>b</sup>	0.18
Oysters <sup>d</sup>	0.01
Perch (freshwater)	0.14
Pollock <sup>d</sup>	0.04
Salmon (fresh/frozen) <sup>c,d</sup>	0.01
Sardines <sup>c,d</sup>	0.02
Scallops <sup>d</sup>	0.05
Shad (American)	0.07
Shrimp <sup>d</sup>	ND
Skate	0.14
Snapper <sup>b</sup>	0.19
Squid	0.07
Tilapia	0.01
Trout (freshwater) <sup>d</sup>	0.07
Tuna (canned chunk light) <sup>d</sup>	0.12
Weakfish (sea trout)	0.26

Table 1. Mercury Levels in Commercial Fish and Shellfish (cont)

SPECIES	MEAN MERCURY LEVEL (parts per million [ppm])
<b>Moderate Mean Mercury Levels (0.3 to 0.59 ppm)</b>	
Bluefish <sup>c</sup>	0.34
Grouper <sup>b</sup>	0.47
Lobster (Northern/American)	0.31
Mackerel, Spanish (Gulf of Mexico) <sup>d</sup>	0.45
Marlin	0.49
Orange roughy <sup>b</sup>	0.55
Tuna (canned, white albacore) <sup>d</sup>	0.35
Tuna (fresh/frozen) <sup>d</sup>	0.38
<b>Highest Mean Mercury Levels (&gt;0.6 ppm): AVOID EATING</b>	
Mackerel-King (Atlantic & Gulf of Mexico) <sup>d</sup>	0.73
Shark <sup>b</sup>	0.99
Swordfish <sup>b,d</sup>	0.98
Tilefish (Gulf of Mexico) <sup>b</sup>	1.45
<p>a) FDA testing has been extremely limited (&lt;10 samples tested) and may not reflect actual contamination levels. b) Some species have been overfished in recent years, and thus may not be good choices for those concerned about fishery sustainability. Visit <a href="http://www.mbayaq.org">www.mbayaq.org</a> for more information. c) These fatty fish may be low in mercury but high in PCBs or other persistent organic pollutants. d) These fish contain &gt;240 mg of omega-3 fatty acids. See Table 2 for specific amounts per serving.</p> <p>Adapted from EPA/FDA, 2006: <a href="http://www.cfsan.fda.gov/~frf/sea-mehg.html">www.cfsan.fda.gov/~frf/sea-mehg.html</a>; and <i>Nutrition Action Health Letter</i>, October 2007.</p>	

result in subtle deficiencies in motor skills, attention, language skills, learning capacity, and memory, as well as other symptoms of neurological damage in children.<sup>17-20</sup> These effects of prenatal exposure have been shown to persist into adolescence, suggesting that at least some neurotoxic effects of intrauterine exposure to methylmercury are irreversible.<sup>20</sup> The National Research Council (NRC) has estimated that neurobehavioral effects in the fetus could occur at methylmercury levels of as low as 58 parts per billion in cord blood.<sup>21</sup> The NRC cautions that children of women who consume large amounts of fish and seafood during pregnancy are at particular risk. Mercury also passes through breast milk, which is an additional reason breastfeeding mothers should minimize fish consumption.

Data presented in the 1999–2002 Centers for Disease Control and Prevention’s third National Exposure Report indicated that measures of methylmercury exposure were below 58 µg/L in all tested children between ages 1 and 5 as well as all women of childbearing age.<sup>22,23</sup> This is good news, as this level is below the “level of concern” for harmful health effects. Six percent of childbearing-age women had levels  $\geq 5.8$  µg/L, however, suggesting that close monitoring is needed to continue to define the safe level of mercury in the blood.<sup>22,23</sup>

**PCBs.** PCBs are a large group of fat-soluble chemicals that were produced from the 1920s to the 1970s for use as lubricants and insulators in electrical equipment. Production of PCBs has been banned in the United States, but large quantities remain in equipment manufactured before the ban was implemented and in the environment.<sup>24</sup> PCBs are highly toxic. They accumulate in fatty fish such as salmon and bluefish, as well as beef and dairy products. PCBs can cause a number of different health effects, depending on the extent of exposure and individual sensitivity.<sup>25,26</sup> They are representative of the lipophilic POPs that can produce negative health effects ranging from subtle biochemical and cellular changes to more serious long-term effects, such as cancer and delays in childhood development. Developing fetuses as well as infants and young children may be particularly vulnerable to the adverse effects of these chemicals because their bodies are immature and rapidly growing.<sup>27</sup> Early life exposure to PCBs can cause harmful neurological effects, leading to learning deficits, poor memory, and behavioral problems.

In 2006, 39 states issued 1,023 consumption advisories for PCBs in freshwater and coastal fish.<sup>15</sup> PCBs and related chemicals tend to accumulate and persist, especially in deep, coldwater bodies such as the Great Lakes and the northern oceans. Although wild salmon from Alaska and elsewhere is contaminated with PCBs, data from the EPA indicate that farmed salmon contains significantly higher concentrations of these contaminants,<sup>28</sup> probably as a result of contaminants in fish feed.

## Translating the Evidence into Fish Consumption Guidelines

A key challenge for health care providers in formulating advice to patients about eating fish is to strike an appropriate balance between reducing risks from fish contaminants and preserving the overall health benefits of eating fish. Though little comprehensive testing of fish for contaminants occurs in the United States, guidelines based on currently available information should inform decision-making about what fish to eat, how much, and how often. In addition, because contaminant levels vary among bodies of water in different geographic areas, guidelines should be tailored to reflect state and regional advisories.<sup>29</sup>

**For most people.** The majority of authorities, including ARHP and PSR, believe that the benefits of consuming seafood regularly, especially those types that are high in omega-3 fatty acids such as salmon, oysters, and rainbow trout, outweigh the risks of exposure

### State and Regional Fish Consumption Advisories

US states, territories, tribal organizations, and certain regional governmental authorities issue fish consumption advisories for their jurisdictions. A comprehensive listing can be found at: [www.epa.gov/waterscience/fish/states.htm](http://www.epa.gov/waterscience/fish/states.htm)

Representative examples include:

#### Illinois

[www.idph.state.il.us/envhealth/fishadv/2008\\_fish\\_advisories.pdf](http://www.idph.state.il.us/envhealth/fishadv/2008_fish_advisories.pdf)

#### Maine

[www.maine.gov/dhs/eohp/fish/2KFCA.htm](http://www.maine.gov/dhs/eohp/fish/2KFCA.htm)

#### Michigan

[www.michigan.gov/documents/FishAdvisory03\\_67354\\_7.pdf](http://www.michigan.gov/documents/FishAdvisory03_67354_7.pdf)

#### Minnesota

[www.health.state.mn.us/divs/eh/fish/eating/safeeating.html](http://www.health.state.mn.us/divs/eh/fish/eating/safeeating.html)

#### North Carolina

[www.epi.state.nc.us/epi/fish/current.html](http://www.epi.state.nc.us/epi/fish/current.html)

#### Oregon

[www.ohd.hr.state.or.us/esc/fishadv.cfm](http://www.ohd.hr.state.or.us/esc/fishadv.cfm)

#### Washington

[www.doh.wa.gov/ehp/oehas/fish/advisoriesmap.htm](http://www.doh.wa.gov/ehp/oehas/fish/advisoriesmap.htm)

**Table 2. Omega-3 Content of Fish and Seafood**

<b>Fish (3 ounces of cooked fish)</b>	<b>Omega-3 Content (mg)</b>
Atlantic salmon, farmed	1,825
Atlantic salmon, wild	1,565
Sardines (King Oscar in water, 2.8 ounces)	1,500
Salmon, canned (Bumblebee, red, pink, or blueback)	1,200
Pacific oysters	1,170
Rainbow trout, farmed	980
Mackerel, canned	1,050
Flounder	425
Sole	425
Halibut	395
Scallops	310
Albacore tuna (StarKist or Chicken of the Sea Solid White Albacore Tuna in water)	240
Pacific cod	235
Blue crab	400
Haddock	200
Chunk light tuna (StarKist or Chicken of the Sea Chunk Light Tuna in water)	140-240
Shrimp	270
Clams	240
Lobster	70

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to contaminants.<sup>1,30,31</sup> Various organizations recommend intakes of omega-3s between 200 and 1,000 mg a day—and a 3-ounce serving of canned salmon, for instance, contains 1,200 mg of omega-3s (both docosahexaenoic acid [DHA] and eicosapentaenoic acid [EPA]).<sup>32</sup>

Two 3-ounce servings of fish a week are recommended, ideally from varieties that are high in DHA and EPA.<sup>1,31</sup> Two servings of

fatty fish twice a week can supply 500 to 1,000 mg of omega-3s.<sup>32</sup> If patients chose to eat more than two servings of fish a week, they should be advised to consume a variety of seafood types (assuming there are no advisories to restrict consumption of fish from local sources).<sup>1,30</sup> Species thought to be relatively low in contaminants and therefore safe to eat include cod, shrimp, canned chunk light tuna, and pollock.<sup>15</sup> If patients choose to eat 6 ounces of albacore (white) tuna or tuna steaks, they should eat no other fish in the same week, as such tuna may contain higher levels of mercury.<sup>1,15</sup> If they eat more than the suggested fish servings one week (because, for instance, they are on vacation in a locale where fish is a specialty), they should be advised to reduce their intake the next week.

**Women of childbearing age who are or may become pregnant or who are breastfeeding.** Like the general population, these patients benefit from consuming seafood, especially varieties that are high in omega-3 fatty acids.<sup>1</sup> In fact, a 2007 study of 8,000 British women published in *The Lancet* found that when women ate more than 12 ounces of seafood weekly during pregnancy, their children had higher verbal intelligence quotient (IQ) scores and better developmental skills than did children of women who ate no seafood or less than 12 ounces of seafood a week.<sup>33</sup> The investigators concluded that the “risks from the loss of nutrients were greater than the risks of harm from exposure to trace contaminants in 340 g [12 ounces of] seafood eaten weekly.”<sup>33</sup>

The IOM says that it is safe for childbearing-age women to consume between 6 and 12 ounces per week of a variety of fish and seafood types.<sup>1</sup> To avoid mercury exposure, they should not eat swordfish, shark, king mackerel, or tilefish.<sup>1</sup> These large species eat other fish and can accumulate mercury over their long lifetimes at levels approaching or exceeding 1 ppm, the EPA maximum recommended level.<sup>18,34</sup> This level of contamination is sufficient to pose a risk to the developing brain of the fetus or infant, even with infrequent fish consumption.

A total of only 6 ounces of white (albacore) tuna or tuna steak should be consumed per week due to concerns about mercury, and women who eat these fish should eat no other types of fish that same week.<sup>15</sup> Other fish varieties that contain “moderate” levels of

mercury include bluefish, grouper, lobster, mackerel, marlin, and orange roughy. Women who are contemplating pregnancy at some point in the future should be counseled that avoiding consumption of mercury-containing fish for 6 to 12 months before becoming pregnant will lower the risk of fetal contamination from this particular food source to a negligible level.

**Patients at risk for heart disease.** Omega-3 fatty acids appear to be particularly beneficial for cardiovascular health.<sup>30,35</sup> A review study published in *JAMA* in 2006 indicated that consuming 1-2 servings a week of omega-3-rich fish reduces the risk of coronary death by 36% and total mortality by 17%.<sup>35</sup> The net benefit of eating fish may be compromised by toxic threats from PCBs and other lipophilic contaminants. A study of organic contaminants in salmon reported in *Science* in January 2004 concluded that, based on the presence of elevated PCB levels, no more than one meal of farmed salmon should be consumed per month.<sup>36</sup> Such reports set up competing concerns: losing the potential health benefits of omega-3 fats derived from fish or risking exposure to toxic pollutants. A strategy between these two extremes is reasonable

### Cooking Salmon and Other Fatty Fish

Encourage patients to prepare fatty fish such as salmon with cooking methods that minimize the risk from fat-soluble contaminants such as PCBs. (Note: This does not remove mercury, which is found in fish muscle rather than in fat.) As the method of preparation affects the healthfulness of fish, breaded fish sticks and fried fish are not recommended as a way to gain omega-3 benefits. The suggestions below are adapted from a guide for expectant mothers, published by the Illinois Department of Natural Resources.

- Trim away fatty areas such as the belly, top of the back, and dark meat along the side.
- Remove or puncture the skin before cooking to allow the fat to drain off.
- Broil, grill, roast, or steam the fish on a rack to allow fat to drain away.
- Do not fry large, fatty types of fish such as salmon and bluefish.
- Throw away fatty drippings; don't use them in other cooking.

### Strategies for Enhancing Cardiovascular Health

- Change your lifestyle—Cardiac health can be enhanced by many dietary and lifestyle factors, including exercise, eating a diet low in saturated fat and cholesterol, preventing obesity, and refraining from cigarette smoking.<sup>35,37,38</sup>
- Eat fish containing omega-3 fats in accordance with ARHP/PSR guidelines for eating fatty fish.
- Increase consumption of plant-derived omega-3 fats—Some evidence suggests that plant-derived omega-3 fats may also have cardiovascular benefits; plant sources include soy and canola oils, tofu, soybeans, walnuts, and flax seeds/oil.
- Reduce overall consumption of other animal fats.

and most health guidelines, including the American Heart Association recommendations, advise people at risk of heart disease to consume fatty fish twice a week.<sup>1,30,31,35</sup> If consumers at risk for heart disease choose to consume more than two servings of seafood per week, they should vary the types of seafood eaten to reduce their exposure risk to contaminants.

**Children's consumption.** It is best for everyone to eat a wide variety of fish and seafood in order to decrease the risk of over-exposure to either mercury or PCBs and related toxicants. This is particularly true for small children, who often tend to eat a limited diet with strong preferences for certain foods. To reduce the risk of high exposure to pollutants from over-consumption of any one fish, parents should be advised to teach children from an early age to enjoy a variety of low-mercury, low-PCB fish and shellfish. Children up to 12 years of age can reasonably eat two 3 ounce servings of fish each week, and can eat up to 12 ounces of fish in a week without safety concerns, according to the IOM report.<sup>1</sup>

Serving sizes should be smaller and proportional to body weight, for example, 1 to 2 ounces for a toddler and 2 to 3 ounces for older and larger children.

Shrimp and canned tuna are the most commonly eaten seafood and they tend to be popular with children. Recent surveys show that shrimp is unlikely to contain mercury but may contain some

PCBs. Tuna does contain mercury, but levels in most cans of chunk light tuna tested by FDA in 2003 were low enough to be safe for children as part of a varied fish and shellfish diet. Fish sticks and fast-food fish sandwiches, also frequently eaten by children, are typically made from fish that are low in pollutants but are not recommended as good sources of omega-3s.<sup>15,40</sup>

## Summary of ARHP/PSR Fish Consumption Guidelines

Fish can be an important part of a healthy diet. Following the guidelines below will help ensure that you enjoy the health benefits of eating fish while minimizing any safety problems related to environmental contaminants in fish and shellfish.

### For women of childbearing age (including adolescent girls):

- Eat between 6 and 12 ounces of low-mercury, omega-3 rich fish per week. Varieties low in mercury include shrimp, canned light tuna, pollock, salmon, and catfish. Those that have high concentrations of omega-3s include salmon, herring, and sardines.
- Trim fat and skin, and use cooking methods that allow fat to drain away to reduce exposure to contaminants.
- When choosing fish to eat, follow local, state, and federal fish advisories.
- Eat no more than 6 ounces of fish per week when consuming canned albacore (white) tuna, tuna steaks, or other fish that is moderately contaminated with mercury. Examples: bluefish, grouper, orange roughy, marlin, and fresh tuna.
- Do not eat any fish high in mercury. Examples: swordfish, shark, king mackerel, and tilefish.

### For children up to age 12:

- Serve children a variety of fish and seafood that are low in mercury and other contaminants and rich in omega-3s (see above). Fish sticks are usually made from fish that are low in pollutants, but are not good sources of omega-3s.
- Limit how frequently children eat fish and seafood to between 6 and 12 ounces a week.
- Limit the amount of each child's serving based on age and body weight. For example, a toddler might eat a serving of 1 to 2 ounces, whereas an older and larger child may be served 2 to 3 ounces of low-mercury fish. Toddlers and small children should probably not be offered fish moderately contaminated with mercury, such as canned white albacore tuna, because—even at reduced serving sizes—they may get too much mercury for their weight.

## Web-Based Resources

(Accessed February 15, 2008)

Agency for Toxic Substances and Disease Registry.  
[www.atsdr.cdc.gov/toxpro2.html](http://www.atsdr.cdc.gov/toxpro2.html)

Association of Reproductive Health Professionals.  
[www.arhp.org](http://www.arhp.org)

Centers for Disease Control and Prevention. National Report on Human Exposure to Environmental Chemicals.  
[www.cdc.gov/exposurereport](http://www.cdc.gov/exposurereport)

Environmental Defense Fund Seafood Selector.  
[www.edf.org/page.cfm?tagID=1521&redirect=seafood](http://www.edf.org/page.cfm?tagID=1521&redirect=seafood)

Environmental Protection Agency Mercury Web site.  
[www.epa.gov/waterscience/fish/](http://www.epa.gov/waterscience/fish/)

Environmental Protection Agency Office of Water. Fish Advisories Web site (includes updated listing of national fish and wildlife advisories).  
[www.epa.gov/ost/fish](http://www.epa.gov/ost/fish)

Environmental Protection Agency. Persistent Bioaccumulative and Toxic Chemical Program.  
[www.epa.gov/opptintr/pbt/](http://www.epa.gov/opptintr/pbt/)

Environmental Protection Agency. Toxics Release Inventory Program.  
[www.epa.gov/tri/tridata/index.htm](http://www.epa.gov/tri/tridata/index.htm)

Food and Drug Administration. What You Need to Know About Mercury in Fish and Shellfish.  
[www.cfsan.fda.gov/~dms/admehg3.html](http://www.cfsan.fda.gov/~dms/admehg3.html)

Monterey Bay Aquarium. Seafood Watch.  
[www.mbayaq.org/cr/seafoodwatch.asp](http://www.mbayaq.org/cr/seafoodwatch.asp)

Physicians for Social Responsibility.  
[www.envirohealthaction.org](http://www.envirohealthaction.org)

United Nations Environment Programme. Mercury Programme.  
[www.chem.unep.ch/mercury](http://www.chem.unep.ch/mercury)

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