



Mercury  
levels in fish bought

# SAFE FISH



in and around  
Washington, DC

[mercuryfacts.org](http://mercuryfacts.org)

A project of the  
Center for Consumer Freedom

“When one looks for cases of children, for instance, who’ve had learning disorders or other things related to mercury, it’s impossible to find them in the literature. There are no proven cases of that ... The risk of toxicity is a theoretical risk, still, at this point in time.”

— Pediatric neurologist Dr. Gary Myers on NPR’s *Science Friday* program (2006)

“The only clinical reports of mercury poisoning from fish consumption are those from Japan in the 1950s and 1960s.”

— University of Rochester scientists Dr. Thomas Clarkson and Dr. Gary Myers, and British Medical Research Council scientist Dr. Laszlo Magos, writing in *The New England Journal of Medicine* (2003)

## SUMMARY

Levels of mercury in commercially available fish have become the subject of intense debate among environmental activist groups, often resulting in statements about food safety that stretch the bounds of both good science and truthful advocacy. While scientists and regulators may aim to protect the public’s health with advisories and warnings about trace levels of mercury in fish, such measures are often out of proportion to the hypothetical health risk.

The unintended consequences of warning consumers away from fish can include negative public-health outcomes. In November 2005 testimony before a California Superior Court, former U.S. Health and Human Services Secretary Dr. Louis Sullivan stated that mercury warning signs in places where fish are sold “scare people away from a healthy food.”<sup>1</sup>

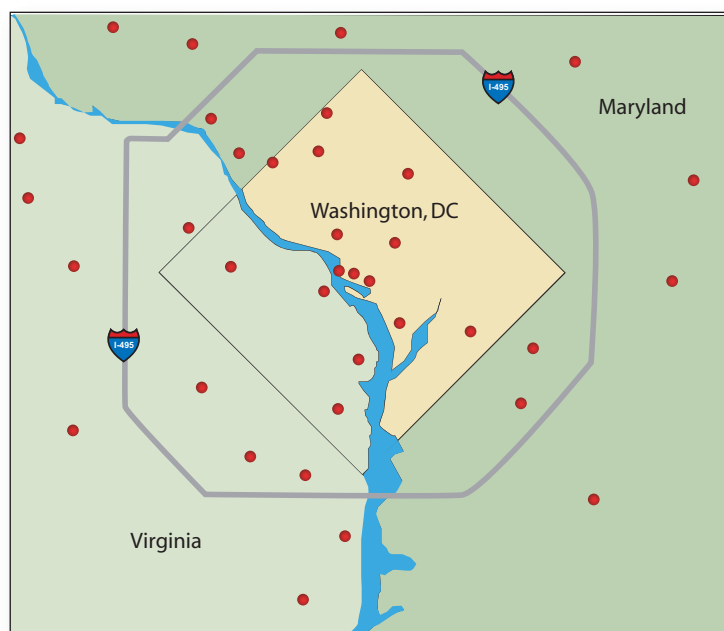
Dr. Sullivan, the Honorary National Chairman of the March of Dimes program to decrease preterm births, discussed the relationship between fish warnings and declining fish consumption—and the connection between *decreased* consumption of Omega-3 fatty acids (which are plentiful in fish) and a substantial *increase* in premature births. The infant mortality rate of the United States ranks a disappointing 27th among industrialized countries.<sup>2</sup> And the March of Dimes estimates that 75 percent of infant deaths in the first month of life involve preterm births.<sup>3</sup>

Because of these and other public health risks associated with the public’s growing fear of fish, the nonprofit Center for Consumer Freedom (CCF) sought to arrive at a realistic conclusion about the levels of mercury in the fish Americans eat, and what (if any) public health consequences these levels might bring.

Figure 1: Fish species and retailers sampled

Fish species	Samples	Samples from grocery chains	Samples from seafood shops
Canned light tuna	24	24	0
Canned albacore tuna	21	21	0
Yellowfin ('ahi) tuna	22	16	6
Swordfish	21	15	6
Chilean sea bass	12	5	7
Rockfish (striped bass)	16	7	9
Salmon (farm-raised)	16	13	3
Salmon (wild-caught)	10	9	1
<b>TOTALS</b>	<b>142</b>	<b>110</b>	<b>32</b>

Figure 2: Geographic distribution of sampled retailers



In February and March 2006, CCF collected 142 samples of fresh and canned fish from 36 retail stores in the Washington, DC metropolitan area. The samples included canned light and albacore tuna, fresh yellowfin (‘ahi) tuna, swordfish, farmed and wild salmon, Chilean sea bass, and rockfish (striped bass).

Frontier GeoSciences Inc., an independent laboratory in Seattle, performed scientific tests to determine the concentration of mercury in the fish samples. Individual mercury levels ranged from 2.85 parts per million (the highest swordfish sample) to less than 0.01 parts per million (the lowest sample of farmed salmon).

Based on the Food and Drug Administration’s description of its regulatory “Action Level” for mercury in fish tissue, **every fish sampled in this study is safe to eat**. The FDA has written that its Action Level (currently set at 1.0 part per million) “was established to limit consumers’ methyl mercury exposure to levels 10 times lower than the lowest levels associated with adverse effects.”<sup>24</sup>

Adjusting for this 1,000-percent cushion, 10.0 (ten) parts per million is actually the minimum level that the FDA believes might represent a health concern for the fish-buying public.

**The highest mercury level measured in this study was 350 percent lower than 10.0 parts per million, which the FDA indicates is “the lowest level associated with adverse effects” to human health.**

These results are similar to those reported by a number of environmental organizations during the past year, none of which identified a single fish whose mercury level represents an actual human health hazard.

“Most of us should be eating more fish. It’s an excellent source of protein and it contains essential vitamins and minerals, such as selenium and iodine.”

— The United Kingdom's Food Standards Agency (2005)

“[T]he existing evidence suggests that methyl mercury exposure from fish consumption during pregnancy, of the level seen in most parts of the world, does not have measurable cognitive or behavioural effects in later childhood.”

— Johns Hopkins University School of Medicine Professor Dr. Constantine Lyketsos, writing in the British medical journal *The Lancet* (2003)

## TESTING METHODOLOGY

A member of the Center for Consumer Freedom’s research team collected 142 fish samples over two successive weekends in early 2006 (February 24-25, March 3-4). Fish species were selected based on their relative popularity in the Washington, DC market. Tuna, swordfish, and salmon are nationwide seafood staples; rockfish (striped bass) is a popular fish in the Chesapeake Bay region of Maryland; and Chilean sea bass has grown in popularity since it was named “Dish of the Year” by *Bon Appetit* magazine in 2001.

A reasonable effort was made to purchase fish from stores in a diverse range of communities throughout the National Capital Region, including nine in Virginia and ten in Maryland. In the city of Washington, fish were purchased at the popular Maine Avenue Fish Market and at retail outlets in five other neighborhoods.

In total, the fish in this survey came from 36 stores, representing outlets of twelve different grocery chains and eight specialty seafood shops.

Fresh fish was purchased as fillets or steaks, with the exception of three rockfish which were purchased whole and filleted by the retailers. Salmon labeled as “wild caught” was out of season, and therefore assumed to be “previously frozen.”

Canned light tuna samples covered 24 varieties from 18 different brands, including four varieties sold in plastic pouches rather than cans.

Canned albacore samples included 21 varieties from 15 different brands, including four pouch varieties. No individual variety of canned tuna was sampled more than once.

Fish samples were sealed in lab-supplied specimen jars and kept cool with ice packs, then shipped overnight to Frontier GeoSciences Inc.<sup>5</sup> on two successive Saturdays in climate-controlled coolers with temperatures below 3.0° Celsius. Frontier GeoSciences tested the fish for total mercury, and re-tested ten samples for quality control. (See Appendix D for technical details.)



A seafood counter at Washington’s Maine Avenue Fish Market

## MERCURY LEVELS (in parts per million)

For tables of all reported raw data, see Appendix A.

### Canned light tuna – 24 samples

Average mercury level:	0.164
Highest level:	0.665
Lowest level:	0.023
Standard deviation:	0.163

### Canned albacore tuna – 21 samples

Average mercury level:	0.364
Highest level:	0.672
Lowest level:	0.053
Standard deviation:	0.132

### Yellowfin ('ahi) tuna – 21 samples

Average mercury level:	0.352
Highest level:	1.180
Lowest level:	0.071
Standard deviation:	0.269

### Swordfish – 21 samples

Average mercury level:	1.328
Highest level:	2.850
Lowest level:	0.563
Standard deviation:	0.600

### Chilean sea bass – 12 samples

Average mercury level:	0.496
Highest level:	1.080
Lowest level:	0.121
Standard deviation:	0.319

### Rockfish (striped bass) – 16 samples

Average mercury level:	0.199
Highest level:	1.490
Lowest level:	0.023
Standard deviation:	0.361

### Farm-raised salmon – 16 samples

Average mercury level:	0.024
Highest level:	0.043
Lowest level:	0.009
Standard deviation:	0.009

### Wild-caught salmon – 10 samples

Average mercury level:	0.035
Highest level:	0.053
Lowest level:	0.009
Standard deviation:	0.012



Canned tuna samples

“We know there will be people above the [EPA’s mercury] Reference Dose, above the tenfold safety factor. But not far above it. They will be in the zone of safety.”

— Dr. David Acheson, the Food and Drug Administration’s Chief Medical Officer, in *The Washington Times* (2004)

“From all the reports we had seen about mercury and its impact on development, we thought we would be able to show how bad it was for children. But we didn’t find it at all.”

— University of Rochester Pediatrics Professor Dr. Philip Davidson, telling *The Medical Post* about his study of heavy fish-eaters in the Seychelles Islands (2006)

## TEN-FOLD SAFETY FACTORS AND THE “REFERENCE DOSE”

Trace levels of mercury in fish have become the subject of intense debate in scientific and advocacy circles. Some activists, journalists, and regulators have issued fearsome statements about mercury toxicity from fish without taking into account the significant safety margins built into government advisory levels.<sup>6</sup>

The FDA’s Action Level is not the only advisory benchmark with a wide, built-in margin of safety. The Environmental Protection Agency’s “Reference Dose” for mercury—which represents that agency’s judgment of the highest “safe” daily intake over a person’s entire lifetime—also includes a 10-fold safety cushion.<sup>7</sup>

In calculating its mercury Reference Dose, the EPA first decided on a “Benchmark Dose Lower Limit” (BMDL), which corresponds to the lowest level of daily exposure (over a lifetime) that may bring negative health effects. This BMDL—not the Reference Dose—represents the EPA’s theoretical harm threshold. (At levels up to the BMDL, “harm” is likely to be undetectable in individuals.<sup>8</sup>) The mercury Reference Dose is merely one-tenth the BMDL.

Even so, considerable scientific disagreement exists concerning whether the BMDL itself was set too low. When the EPA determined how much mercury is “too much,” it relied primarily on a study of the population of the Faroe Islands.<sup>9</sup> But the Faroese may not be an appropriate model for mercury intake in the United States, as they supplement their diets with large amounts of pilot whale.<sup>10</sup> This whale meat and blubber is contaminated with a wide variety of toxins including dioxins, PCBs<sup>11</sup>, and cadmium.<sup>12</sup>

This makes it problematic to determine if mercury, by itself, is responsible for any negative health outcomes—especially when those outcomes are few<sup>13</sup> and largely irrelevant to individuals.<sup>14</sup>

In an ongoing study of heavy fish-eaters in the Seychelles Islands, researchers have been unable to detect negative health effects from mercury in fish.<sup>15</sup> This assessment includes 16 years of tracking more than 700 children (now teenagers) whose mothers’ mercury levels were elevated during pregnancy.<sup>16</sup> Seychelles natives eat approximately ten times as much fish as typical Americans,<sup>17</sup> but pilot whale is not a part of their diets. The failure of the Environmental Protection Agency to emphasize this study’s findings when determining the BMDL for mercury remains unexplained.

Given the ten-fold safety factor built into the mercury Reference Dose (and accounting for the possibility that the EPA’s decision to ignore the Seychelles research may have rendered the BMDL artificially low), the “safe” consumption levels for all species of fish should be understood as ten times higher than what published EPA advisories suggest.

For example, mercury levels in the 24 cans of light tuna sampled in this study averaged 0.164 parts-per-million (ppm). Adjusting for the ten-fold safety factor in the EPA’s Reference Dose, a woman of average weight living in the Washington, DC metropolitan area can safely consume over 105 ounces of canned light tuna (that’s more than 17 cans) *every week for the rest of her life* before risking any theoretical negative health effects.

**Figure 3: Realistic weekly fish intake limits**

Fish species	Average mercury level, in parts per million	Weekly fish intake limit (average-weight male), in ounces	Weekly fish intake limit (average-weight female), in ounces
Swordfish	1.328	16.1	13.8
Chilean sea bass	0.496	43.1	37.0
Canned albacore tuna	0.364	58.8	50.5
Yellowfin ('ahi) tuna	0.352	60.8	52.5
Rockfish (striped bass)	0.190	112.6	96.7
Canned light tuna	0.164	130.4	112.0
Salmon	0.028	764.0	656.0

Calculations based on the Benchmark Dose Lower Limit (BMDL) for methyl mercury as determined by the U.S. Environmental Protection Agency. Average weight for males (191 pounds) and females (164 pounds) from *Mean Body Weight, Height, and Body Mass Index (BMI) 1960-2002: United States* (Centers for Disease Control and Prevention)

Even swordfish, which tested highest for mercury in this survey, and which is the subject of EPA advisories directed at reproductive-age women and small children, can be safely eaten twice a week (assuming a typical serving size) over long periods of time. Both the BMDL and the hyper-precautionary Reference Dose are meant to be lifetime consumption guidelines. In a 2004 joint advisory, the EPA and FDA conceded that “one week’s consumption of fish does not change the level of methyl mercury in the body much at all.”<sup>18</sup>

The FDA is aware that health advice based on the mercury Reference Dose can lead consumers to fear a nonexistent harm. In 2004, FDA Chief Medical Officer Dr. David Acheson acknowledged: “We know there will be people above the Reference Dose, above the tenfold safety factor. But not far above it. They will be in the zone of safety.”<sup>19</sup>

And during a 2002 joint FDA/EPA meeting, FDA Contaminants Branch chief Dr. Michael Bolger remarked that “ninety-two percent of women of childbearing age already consume below the Reference Dose ... the remaining women, approximately the top 8 percentile, still have a margin of safety of about eight-fold.”<sup>20</sup>



Yellowfin tuna, rockfish, and swordfish sold at an upscale suburban-Virginia grocery store

“Mercury is in the ocean. So in theory there is risk associated with fish consumption. But the types of risk are not the frank poisoning events one might picture associated with mercury. We are talking about subtle effects not detectable at the level of the individual. That is because the amount of mercury people are exposed to in the U.S. is not very great.”

— Harvard School of Public Health researcher Dr. Joshua Cohen, speaking to *WebMD Medical News* (2005)

“At the levels of mercury that we found—about average for the general population—there were no cognitive effects.”

— Johns Hopkins University’s Dr. Megan Weil, on her 2005 study published in *The Journal of the American Medical Association*

## OTHER RECENT FISH-MERCURY SURVEYS

The results of this survey are comparable to the long-term data made publicly available by the Food and Drug Administration.<sup>21</sup> **Based on the FDA’s analysis of its mercury Action Level, fourteen years of the agency’s testing has failed to identify any fish samples whose mercury levels represent a genuine health risk. This report found similarly safe levels in all tested fish.**

Our results are also similar to testing results published in 2005 and 2006 by *The Chicago Tribune* and two environmental activist groups (Oceana and the Sea Turtle Restoration Project). These other reports, however, entirely ignored the impact of built-in safety margins, claiming incorrectly that fish samples exceeding the FDA’s mercury Action Level were inherently unsafe to eat.

According to the *Tribune*, the highest mercury reading in its survey was a swordfish whose concentration was 3.07 ppm.<sup>22</sup> Considering the Action Level’s built-in safety factor, this is less than one-third of the level that might be harmful. No other species averaged above 1.0 ppm. And despite a later editorial complaining about “Tuna Roulette,” the *Tribune* was unable to find a single sample of tuna that exceeded the mercury Action Level.

Despite Oceana’s call for warning labels and signs in grocery stores, its own 2005 survey of tuna and swordfish<sup>23</sup> concluded with similar results. No sample of tuna in Oceana’s survey approached the FDA’s mercury Action Level (the highest measurement was 0.684 ppm). And while half of

Oceana’s swordfish samples exceeded the Action Level, none approached the actual level of health concern, which is ten times greater. The highest mercury level Oceana reported in swordfish, 2.328 ppm, is less than one-fourth of what might constitute a health risk.

Oceana’s other recent data, published in February 2006, consisted of mercury levels from 190 fish caught during a July 2005 Gulf of Mexico fishing tournament.<sup>24</sup> Across all 30 species sampled, the average mercury level was 0.53 ppm, or barely half the FDA’s Action Level. Put another way, the average mercury concentration in this study was barely five percent of the level that might be harmful. The highest mercury level was a 3.97-ppm king mackerel, which still enjoys a 250-percent safety margin.

The Sea Turtle Restoration Project’s 2006 surveys of tuna sushi in Los Angeles<sup>25</sup> and San Diego<sup>26</sup> restaurants are particularly problematic. Based on a total of 12 pieces of fish from Los Angeles, the organization claimed in March 2006 that “women and children should not eat tuna served as sushi or sashimi.” Yet the highest mercury level in this survey was 1.01 ppm, representing barely one-tenth of the level that would justify such alarm.

The group’s May 2006 survey of San Diego sushi restaurants—carried out in cooperation with KGTV News—included 20 pieces of tuna, but its results were equally skewed.

Despite the fact that it found no tuna with mercury levels above the FDA's Action Level (the highest sample was 0.967 ppm), the Sea Turtle Restoration Project invented its own food-safety standard and claimed that 20 percent of the sampled fish were "unsafe for women and children to consume."

In addition, North Carolina's Neuse River Foundation<sup>27</sup>, the Illinois Public Interest Research Group<sup>28</sup>, and the Maryland Public Interest Research Group<sup>29</sup> have each published data in 2006 indicating "unsafe" or "dangerous" levels of mercury in freshwater fish.

These three groups based their claims about the healthfulness of fish on the EPA's "Ambient Water Quality Criterion" (AWQC), a measurement whose use is intended to determine water pollution levels, not food safety.<sup>30</sup> The AWQC is currently set at 0.3 ppm. This is 70 percent lower than the FDA's more appropriate Action Level—which itself already includes a 1,000-percent safety factor.

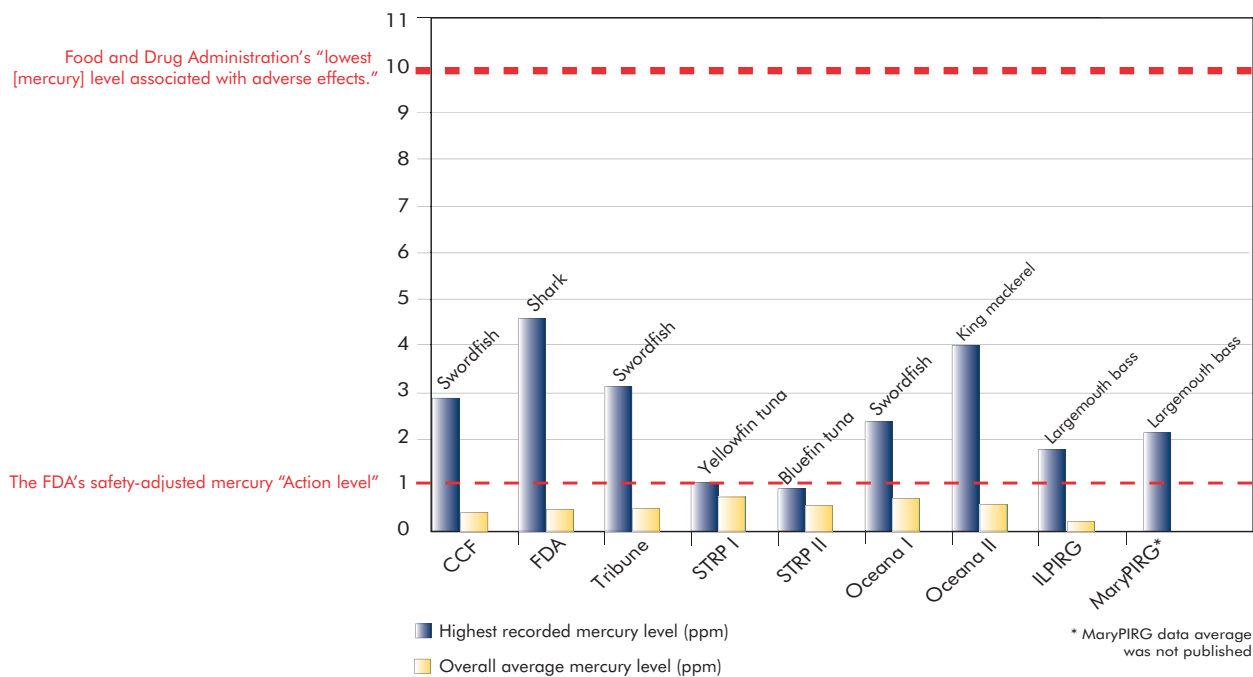
**In truth, no fish tested in any of these studies is unsafe to eat.**

Maryland PIRG found only two species of fish (out of 36) that tested above the FDA's mercury Action Level. The highest measurement, in a largemouth bass whose mercury level was 2.08 ppm, provides consumers with a 481-percent safety margin.

Similarly, Illinois PIRG found a sample of only one fish species (out of 32) that exceeded the Action Level. The highest mercury reading, in a largemouth bass whose mercury concentration was 1.40 ppm, is 714 percent lower than a level that would justify health concerns.

The Neuse River Foundation has not released its test results, stating only that 16 out of 81 fish exceeded the EPA's AWQC level of 0.3 ppm. It is unlikely that any fish in this survey actually contained enough mercury to pose a health risk to fishermen or their families.

**Figure 4: "High" mercury levels in fish surveys, compared to a theoretical harm threshold**



## APPENDIX A: Individual mercury levels (in parts per million)

Canned light tuna	Canned albacore tuna	Yellowfin ('ahi) tuna	Swordfish
0.665	0.672	1.180	2.850
0.493	0.562	0.896	2.010
0.383	0.499	0.539	1.990
0.357	0.498	0.522	1.930
0.253	0.488	0.509	1.770
0.216	0.474	0.466	1.710
0.207	0.384	0.431	1.640
0.180	0.355	0.412	1.560
0.172	0.345	0.377	1.560
0.139	0.340	0.324	1.470
0.094	0.333	0.292	1.220
0.094	0.331	0.248	1.190
0.093	0.328	0.211	1.060
0.089	0.319	0.207	0.995
0.077	0.307	0.193	0.977
0.071	0.288	0.191	0.766
0.071	0.280	0.161	0.672
0.068	0.279	0.152	0.666
0.046	0.265	0.130	0.654
0.038	0.245	0.130	0.630
0.037	0.053	0.107	0.563
0.035		0.071	
0.024			
0.023			

Chilean sea bass	Rockfish (striped bass)	Wild-caught salmon	Farm-raised salmon
1.080	1.490	0.053	0.043
0.826	0.391	0.047	0.038
0.813	0.332	0.042	0.031
0.778	0.215	0.039	0.028
0.675	0.123	0.039	0.027
0.411	0.115	0.038	0.027
0.298	0.091	0.033	0.025
0.291	0.079	0.030	0.023
0.250	0.078	0.024	0.021
0.216	0.066	0.009	0.021
0.195	0.051		0.020
0.121	0.035		0.020
	0.035		0.017
	0.032		0.017
	0.027		0.014
	0.023		0.009

## APPENDIX B: Retail stores sampled

### **Balducci's**

6655 Old Dominion Drive  
McLean, VA 22101

### **Balducci's**

3201 New Mexico Avenue, NW  
Washington, DC 20016

### **Cannon's Seafood**

1065 31st Street, NW  
Washington, DC 20007

### **Captain White's Seafood City**

1100 Maine Avenue, SW  
Washington, DC 20024

### **Chevy Chase Seafood Market**

5509 Connecticut Avenue, NW  
Washington, DC 20015

### **Costco**

4725 West Ox Road  
Fairfax, VA 22030

### **Dean & Deluca**

3276 M Street, NW  
Washington, DC 20007

### **Food Lion**

845 Rockville Pike  
Rockville, MD 20852

### **Food Lion**

8750 Richmond Highway  
Alexandria, VA 22309

### **Giant**

2901-11 South Glebe Road  
Arlington, VA 22206

### **Giant**

5400 Westbard Avenue  
Bethesda, MD 20816

### **Giant**

10480 Campus Way South  
Largo, MD 20774

### **Giant**

4119 Branch Avenue  
Marlow Heights, MD 20748

### **Giant**

6011 Burke Center Parkway  
Burke, VA 22015

### **Global Foods**

13813 Foulger Square  
Woodbridge, VA 22192

### **Harris Teeter**

6351 Columbia Pike  
Falls Church, VA 22041

### **Harris Teeter**

900 Army Navy Drive  
Arlington, VA 22202

### **Jessie Taylor Seafood**

1100 Maine Avenue, SW  
Washington, DC 20024

### **Maxim Gourmet**

**Oriental Market**  
460 Hungerford Drive  
Rockville, MD 20850

### **Potomac Seafood**

3835 Pennsylvania Avenue, SE  
Washington, DC 20020

### **River Falls Seafood Company**

10124 River Road  
Potomac, MD 20854

### **Safeway**

5545 Connecticut Avenue, NW  
Washington, DC 20015

### **Safeway**

8785 Branch Avenue  
Clinton, MD 20735

### **Safeway**

5980 Kingstowne Centre  
Alexandria, VA 22315

### **Safeway**

3830 Georgia Avenue, NW  
Washington, DC 20011

### **Shopper's Food Warehouse**

4720 Cherry Hill Road  
College Park, MD 20740

### **Shopper's Food Warehouse**

6360 Seven Corners Center  
Falls Church, VA 22044

### **Shopper's Food Warehouse**

4801 Marlboro Pike  
Coral Hills, MD 20743

### **Super Fresh**

4825 Glenn Dale Road  
Bowie, MD 20720

### **Super Fresh**

3901 Aspen Hill Road  
Wheaton, MD 20906

### **Trader Joe's**

12268-H Rockville Pike  
Rockville, MD 20852

### **Trader Joe's**

6394 Springfield Plaza Road  
Springfield, VA 22150

### **Wegmans**

11620 Monument Drive  
Fairfax, VA 22030

### **Wegmans**

45131 Columbia Place  
Sterling, VA 20166

### **Whole Foods**

1440 P Street, NW  
Washington, DC 20005

### **Whole Foods**

5269 River Road  
Bethesda, MD 20816

## APPENDIX C: About Frontier GeoSciences Inc.

Frontier GeoSciences Inc. (FGS) is a leading environmental analytical laboratory that specializes in the determination of trace metals at ultra low levels.

FGS has been instrumental during the past decade in developing the ultra-clean sampling techniques, analytical methods, and sound scientific procedures used all over the world to measure trace metals levels.

Located in Seattle, Washington, FGS provides quality analytical data to federal agencies including the Environmental Protection Agency, the U.S. Geological Survey, the National Oceanic & Atmospheric Administration, and the Department of Energy. FGS also contracts with state departments of health in Washington and New York, focusing on trace metal levels in surface water, plant and animal tissue, and soil and sediments.

FGS is staffed by over fifty scientific professionals, and its analytical methods have been rigorously tested and certified by the National Environmental Laboratory Accreditation Program.

## APPENDIX D: Technical Information from Frontier GeoSciences Inc.

One hundred forty-two (142) fish tissue samples were submitted for total mercury analysis using cold vapor atomic fluorescence spectrometry (CVAFS).

All samples were received in sealed coolers with temperatures below 3.0°C. All samples were logged in according to Frontier's protocols on the day of receipt and placed in a secure freezer until sample processing occurred.

Samples were processed using ultra-clean sample handling techniques in laminar flow clean areas known to be low in atmospheric trace metals. Reagents, gases, and de-ionized water are all reagent or ultra-pure grade, and previously analyzed for trace metals to ensure very low blanks.

Daily analytical runs were begun with a 5 point standard curve, spanning the entire analytical range of interest, with additional standards run every 10 samples. The daily standard curves were calculated using the blank-corrected initial standards, a linear regression forced through zero. For each analytical set one matrix duplicate, two matrix spikes, and at least three method blanks were co-processed and analyzed in exactly the same manner as ordinary samples.

Samples were prepared with a 70:30 (v/v) Nitric/Sulfuric ( $\text{HNO}_3/\text{H}_2\text{SO}_4$ ) acid digestion. Briefly, about 0.5 grams of sample was digested with 10 milliliters of acid in Teflon vials, and then the digestate was diluted to 25 milliliters with reagent water. The digest was split and analyzed for mercury via CVAFS.

Digested samples were analyzed for total mercury (Hg) in accordance with the standard operating procedures described in the Frontier Geosciences Quality Assurance manual. Aliquots of each digest (100 milliliters for whole water) were reduced in pre-purged double-distilled water to  $\text{HgO}$  with  $\text{SnCl}_2$ , and then the  $\text{HgO}$  purged onto gold traps as a pre-concentration step. The Hg contained on the gold traps was then analyzed by thermal desorption into a cold vapor atomic fluorescence detector (CVAFS) using the dual amalgamation technique. Peak heights were measured by chart recorder and recorded on bench sheets in "chart units" to the nearest 0.2 unit.

There were no analytical difficulties experienced with these samples. All blanks, standard reference materials, matrix spikes and matrix spike duplicate samples were within established quality control limits.



Fresh fish samples in specimen jars

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