IS OUR TUNA "FAMILY-SAFE"?

Mercury in America's Favorite Fish

Defenders of Wildlife

Mercury Policy Project

Center for Science in the Public Interest

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EXECUTIVE SUMMARY

Mercury from power plants and other sources contaminates our oceans and marine life, including yellowfin and other commercially important tuna species. Consequently, canned tuna is now a major source of mercury in our diets.

Tuna, especially canned tuna, is the most popular fish among American consumers and a staple in the diet of many children. Americans have long demanded that their tuna be "dolphin-safe," but mounting evidence of high levels of mercury in tuna and other fish raises another serious concern: Is our tuna human-safe?

Mercury is a potent poison linked to human health problems ranging from brain damage and neurological impairment in children to memory loss and heart attacks in adults. Mercury from power-plant emissions and other industrial sources is deposited in our oceans and waterways, where it accumulates in the bodies of fish in the form of methylmercury. Eating contaminated fish is the most significant source of exposure to methylmercury for humans. Recent studies suggest hundreds of thousands of babies born each year are exposed to excessive levels of methylmercury at the most vulnerable period of their lives—before they even leave the womb.

Given its popularity, canned tuna is the largest dietary source of mercury exposure in the United States.

Testing the Limits

In response to the growing evidence of risks associated with mercury, the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA) issued guidelines on the consumption of tuna and other fish in 2004. Defenders of Wildlife, long a champion of the dolphin-safe-labeling program and an advocate for healthy and environmentally sound fisheries worldwide, is concerned that these guidelines are not protective enough. The government based their most recent guidelines on tests of mostly American brands of tuna, even though a growing proportion of the canned tuna consumed today in the United States. is imported. In 2004, for example, 51 percent of the total U.S. supply of canned tuna came from foreign sources.

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Defenders conducted this study to determine whether all canned light and albacore tuna is similar in mercury content, as the current federal guidelines suggest. We also wanted to look at how factors such as country of origin, fishing method, size and species composition of the tuna might affect the amount of mercury in each can. We commissioned independent testing of 164 cans of tuna collected from both large chains and smaller independent groceries around the country. Our study included not only U.S.-processed tuna, but also tuna canned in Costa Rica, Ecuador, Malaysia, Mexico, the Philippines, Thailand and other countries—making it the first study of imported canned tuna in the United States.

Disturbing Results

Our testing results revealed high levels of mercury in canned tuna, including light tuna, which the FDA has categorized as a "low-mercury fish." A significant proportion of light tuna we sampled contained levels of mercury high enough to pose a potential public health risk, particularly to children and developing fetuses. More than one-third (35 percent) of all cans in our sample had mercury levels above 0.3 parts per million (ppm). Eating just one six-ounce can of this tuna a week would cause a 140 pound woman—and nearly all children—to exceed the EPA's "reference dose" for mercury. In fact, based on this study, a 45-pound child eating one can of light tuna in a week would be consuming mercury at a level three times higher than the EPA's recommended maximum allowable dose of mercury. This is particularly alarming because tuna is a staple of federal efforts such as the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) and the school lunch program. Currently, canned tuna is the only animal meat protein source offered by the U.S. Department of Agriculture and state WIC programs, with the exception of the WIC programs offered in Alaska and Hawaii. By promoting tuna as a major source of protein through these programs, the government may be inadvertently putting low-income women and children at greater risk of mercury exposure.

Mercury levels in the samples tested varied widely. While light tuna from Asia was generally low in mercury, average levels of mercury found in the Latin American tuna tested were surprisingly high—more than 0.4 ppm. Samples from one country, Ecuador, had an astounding 0.75 ppm average mercury content. By comparison, the FDA/EPA advisory recommends that consumers avoid king mackerel, a fish with an average mercury level of 0.73 ppm. More troubling, several of the cans from Latin America reached levels over the 1.00 ppm "action level" at which the FDA can pull tuna from supermarket shelves to protect public health. One can had 1.50 ppm of mercury, and nearly one in every 20 cans of light tuna exceeded the 1.00 ppm FDA action level.

The Dolphin-Safe, Family-Safe Link

In the eastern Pacific Ocean, pods of dolphins routinely swim with large, mature yellowfin tuna. Some commercial fishing vessels exploit this relationship by setting purse-seine nets on dolphins to catch the large tuna swimming below. Since mercury concentrations in fish increase with the size and age of the fish, and tuna caught in dolphin 'sets' are generally the oldest and largest tuna, it is reasonable to infer that this 'dolphin-unsafe' fishing method results in tuna with higher mercury concentrations than tuna caught by other means.

Our study found that tuna from two countries with a documented history of dolphin-unsafe fishing, Ecuador and Mexico, had the highest mercury concentrations of all samples tested. The disproportionately high mercury levels in these samples suggest that some countries are not only violating international dolphin-protection standards, but also creating a significant health risk for consumers. While the evidence is not conclusive, our data support further investigation into this possibility—especially since some minority and immigrant groups may favor tuna from these countries. Our results also suggest that Bush administration's efforts to weaken the dolphin-safe label may have serious and unintended consequences for public health.

A Call for Action

The high levels of mercury found in certain types of canned tuna pose a health threat to families, primarily to women and their children. Consumers have no way of knowing the mercury levels of the tuna because it is nearly impossible to determine what species of tuna the product is made from, the size and age of the fish, where the fish was caught or what method was used to catch it. The current federal guidelines do not address these critical factors. Therefore, we urge our government to take the following steps to protect consumers:

1. Conduct a more thorough assessment of the mercury content in canned tuna by looking at the growing market of imported canned tuna and paying greater attention to the higher mercury levels found in Latin American varieties.
2. Issue warnings for canned light tuna equivalent to those for albacore tuna (six ounces per week maximum) until the FDA can conduct more comprehensive tests on imported tuna. Advise parents to limit their children's consumption of canned tuna to three ounces (half a can) or less per week. This would better protect vulnerable populations and serve as a responsible model for state advisories.
3. Reassess the role of canned light tuna in government food-support programs such as WIC and the federal school lunch program.
4. Effectively enforce the FDA's 1.00 ppm action level for the sale and importation of canned tuna and other fish with excessive levels of mercury. In addition, update and extend the FDA's Hazard Analysis and Critical Control Point (HACCP) guidelines to recognize mercury as a likely hazard and require seafood industry controls to monitor for high mercury content in fish.
5. Investigate the potential link between environmentally destructive dolphin 'sets' and mercury concentrations.

In conclusion, it is the government's duty to make America's favorite fish family-safe and provide consumers with the information they need to make informed choices. The government should keep canned tuna with excessive mercury off the market and give consumers clear and well-researched advice on tuna consumption to protect us from unacceptable exposure to mercury—regardless of where we live or what kind of tuna we can afford.

I. THE MERCURY THREAT

Organic mercury (methylmercury) is a potent environmental poison linked to a number of human health risks, ranging from brain damage and neurological impairment in children to memory loss and heart attacks in adults. Although mercury is widespread in the environment, the only significant source of methylmercury exposure for humans is through consumption of contaminated fish, primarily tuna.

Tuna is the best-selling fish in America and the second most popular seafood after shrimp. The sheer volume of canned tuna consumed makes it the largest single dietary source of mercury exposure in America and a potentially serious threat to public health.

Despite mounting evidence that mercury poisoning from seafood is a major health threat, particularly to pregnant women, their developing fetuses and young children, little information is available to the public about how much mercury is really in tuna. In light of the risks involved, it is imperative that the public receive clear and accurate advice on how to avoid harm from mercury contamination.

Mercury in the Environment: Pathways to Wildlife and Humans

Although some mercury occurs naturally in the environment, the majority (70 percent) of the mercury currently circulating in our atmosphere is from human sources, mainly industrial emissions from power plants, waste incineration and other activities (Schuster et al. 2002).[1]

When released into the environment through power plant emissions, chlori-alkali plants and other sources, mercury enters into the atmosphere in an inorganic form. It is then deposited on land and into oceans, lakes and other water bodies both near the source and miles away. Once it enters the water cycle, however, it is methylated (chemically changed primarily by micro-organisms and bacteria in the aquatic environment) into an organic form that can accumulate in the bodies of fish and humans (see Figure 1). This organic mercury is easily absorbed by the blood and muscle tissue of fish and other organisms and accumulates as it goes up the food chain, with animals at each successive level consuming and absorbing mercury in progressively higher doses.

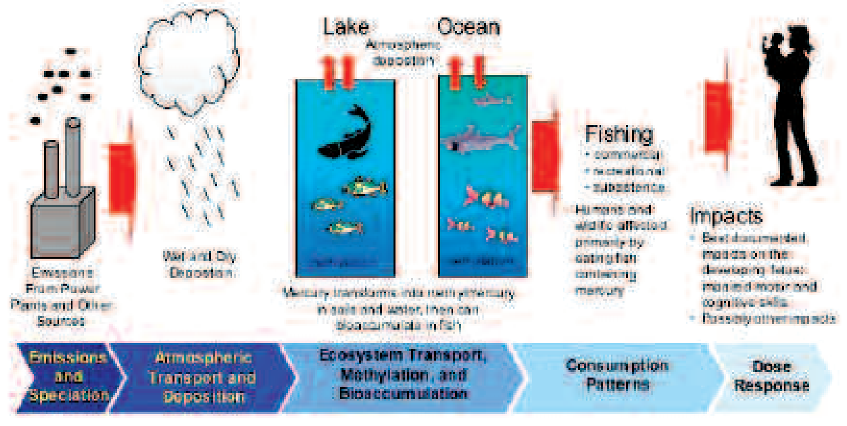
Due to this process, the most dangerous levels of mercury are generally found in organisms that are higher on the food chain. As a result, large predatory fish such as tuna, sharks and swordfish are likely to have high levels in their bodies. In addition, older, bigger fish are likely to have the highest levels of mercury within their species. The longer a fish lives and the larger the fish it consumes, the more mercury it takes in and the longer the mercury has to accumulate in its tissues and bloodstream. According to the U.S. Environmental Protection Agency (EPA), predatory fish can have concentrations of mercury in their tissues that may be a million times higher than the concentrations in the water (EPA 2004).

Hence the level of mercury varies considerably depending on the species of fish, its place in the food chain, the age and size of the individual fish and the area in which it lives. (Mercury concentrations are frequently higher in areas close to sources of mercury pollution.)

The sheer volume of canned tuna consumed makes it the largest single dietary source of mercury exposure in America.

Humans, at the top of the food chain, are subject to the same impacts of accumulation over time. Fish consumption is the primary way the general public is exposed to methylmercury, and, because of its toxicity, the dietary intake of methylmercury is considered the most serious general impact of mercury on humans (United Nations Environment Programme 2002). The more fish we eat and the higher the particular fish is on the food chain, the higher the levels of mercury we ingest. Moreover, unlike

Figure 1: How Mercury Enters the Environment



SOURCE: U.S. ENVIRONMENTAL PROTECTION AGENCY

PCBs and other toxins that tend to be found in the fat of fish, methylmercury is pervasive throughout the organism, primarily in blood and muscle tissue. For this reason, mercury, unlike PCBs and other toxins, cannot be removed from fish by simply cutting away the fat.

Mercury in Humans: Public Health Risks of Fish Consumption

The mercury found in fish is a potent neurotoxin that can cause nervous system and brain damage in young children, infants and developing fetuses. Methylmercury that enters the human bloodstream is readily absorbed by the brain, where it can seriously disrupt normal development of the central nervous system.

Because their brains are rapidly developing and represent a larger part of their body mass, developing fetuses and small children are at particular risk from methylmercury poisoning. Mercury is frequently implicated in the increase in childhood neurological disorders such as attention-deficit disorder (ADD) and learning disabilities (National Research Council 2000). Low-dose exposure through maternal fish consumption has been linked to poor performance on tests of attention, fine-motor function, language, visual-spatial abilities (e.g., drawing) and verbal memory (National Research Council 2000). Prenatal exposure to mercury has been found to irreversibly impair certain brain functions in children (Grandjean et al. 2004b). In extreme cases, mercury poisoning has led to mental retardation, cerebral palsy, deafness and blindness (National Research Council 2000). Mercury exposure has also been linked to heart arrhythmias in children (Grandjean et al. 2004a).

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State-issued fish-consumption warnings are increasingly common on America's mercury-contaminated waterways.

Comprehensive assessments by the U.S. Centers for Disease Control and Prevention (CDC) found that more than 6 million American women—one out of every 10 women of child-bearing age—have levels of methylmercury in their blood that exceed levels considered safe for fetuses (CDC 2004, CDC 2001, McDowell et al. 2004). As a result, leading scientists in the field, including one of the EPA's leading methylmercury experts, estimate that as many as 410,000 babies—one out of every 10 born in the United States annually—are exposed to dangerously high levels of mercury in the womb (Mahaffey 2005; Trasande et al. 2005). The fetal brain is considered 10 to 15 times more susceptible to mercury poisoning than the brains of older children and adults (Shea and Shannon 2004). While the risks are most serious to developing fetuses in the womb, methylmercury from fish consumption can also contaminate breast milk and expose babies to additional mercury postnatally through breastfeeding (Drexler et al. 1998). Mercury exposure may be an important contributing factor to what experts call a crisis in child health, with developmental abnormalities and other mercury-related illnesses reaching epidemic proportions (Anonymous 2000; Schettler et al.2000; American Lung Association 2005).[3]

Moreover, mercury exposure does not end with infancy. It continues throughout childhood and into adulthood, whenever we eat contaminated fish. And while young children and women of childbearing age are the primary focus of health advisories, methylmercury has also been linked to health problems in adults, including memory loss (Guallar et al. 2002) and increased risk of heart disease (Stern 2005a; Guallar et al. 2002). Studies have also found that mercury exposure may have adverse effects on the immune system (National Research Council 2000) and result in loss of neurological function in the elderly (Yokoo et al. 2003). Thus, while fish advisories tend to focus on women and children, anyone, including the general adult population, can be adversely affected by mercury in fish if they are exposed to it in high enough doses. Significantly, some effects documented in adults have been linked to levels of mercury exposure lower than those currently believed harmful to the developing brain, suggesting that mercury may negatively affect a far larger proportion of the population than previously suspected.

II. EXPOSURE TO MERCURY FROM TUNA CONSUMPTION

A yellowfin tuna begins its journey to the table. Hotly pursued by the fishing fleets of many nations, yellowfin accounts for nearly half of the world's canned tuna.

Mercury in tuna is a topic of public concern not only because of the high levels of mercury found in fresh and canned tuna, but because of the large volume of tuna consumed each year in the United States, especially among sensitive populations such as women and children. According to the U.S. Department of Agriculture (USDA), canned tuna is the fish most heavily consumed by children and women of childbearing age (Smiciklas-Wright et al. 2002). A recent report by a coalition of eight states estimates that tuna alone accounts for 33 percent of per capita exposure to mercury (NESCAUM 2005). Thus, the combination of mercury content in tuna and the sheer volume of current consumption makes canned tuna the largest dietary source of methylmercury exposure for the American public.

High U.S. Demand for Tuna

Canned tuna is consumed by an estimated 96 percent of U.S. households and represents the number-three item in U.S. grocery stores, behind sugar and coffee (U.S. Tuna Foundation 2003). The United States represents the largest single-country market for canned tuna in the world.

Rising Imports of Canned Tuna

America's canned tuna increasingly comes from foreign sources. After years of rapid growth, imported tuna surpassed U.S.-packed tuna for the first time in 2004. The National Marine Fisheries Service (NMFS) reports that foreign-packed tuna now accounts for 51 percent of America's canned tuna supply by volume (NMFS 2005). Over the last decade alone, foreign imports have increased from nearly a third (29 percent) of the U.S. market in 1994 to a majority of the market in 2004. To compete with foreign tuna companies, more and more U.S. production capacity is relocating to developing countries. As tariffs on foreign tuna drop, or in some cases disappear, canning of tuna in the United States is becoming uneconomical. This trend can be seen in both falling domestic production of canned tuna and growing imports (see Table 1).

In 2003, 459 million pounds of canned tuna were imported into the United States, 81 million pounds more than in 2002. Imports of fresh and frozen foreign-caught tuna also increased by nearly 30 percent between 2002 and 2003, with imports totaling 681 million pounds in 2003 (534 million pounds of which were used for canning) (NMFS 2005). The countries exporting the most canned tuna by volume to the United States in 2003 were Thailand (46 percent of imports), Ecuador (21 percent) and the Philippines (19 percent) (NMFS 2004). In 2004, the Philippines imported slightly more than Ecuador, but the top three importing countries remained consistent (NMFS 2005).

Factors Affecting Mercury Levels in Tuna

The larger the fish and the greater its longevity, the more mercury it will accumulate in its tissues (EPA 1997). As predators, tuna are invariably large fish, with some species reaching lengths of up to 12 feet, weighing more than 1,500 pounds and living as long as 30 years. Their size and predatory nature make tuna especially susceptible to mercury bioaccumulation during their lifetimes.

To understand the potential mercury risk associated with any given can of tuna it is helpful to know: 1) the species of tuna; 2) where the tuna was caught; and 3) the age and size of the actual tuna in the can. At first glance, these seem like easy questions to answer, but in an industry characterized by increasing globalization they prove very difficult. The problem that arises when attempting to determine the species and size of the fish is that with modern-day industrialized fishing and trade infrastructure, it is often impossible for consumers to know even the country of origin of their seafood, much less any details on the individual fish. This is particularly true for tuna, as fleets from numerous countries cross the world's oceans in search of fertile fishing grounds, using methods varying from longlining to purse seining to pole-and-line fishing.

Tuna are highly migratory species that are found in oceans around the world. Since canned tuna has a long shelf life, it can be shipped long distances from where it was originally caught. While the area in which tuna are caught can also play a role in the level of mercury, mercury is so pervasive in the environment that traces can be found in fish from all over the globe, including the Arctic and other areas far-removed from power plants and other human-related sources of emissions (United Nations Environment Programme 2002).

Adding to the confusion is the fact that once caught, tuna is not necessarily processed by the same country that caught it or even the same region where it was caught. Thus, it is increasingly difficult to determine exactly who caught the tuna, how it was caught or even in which ocean.

To complicate matters further, there are eight different species of tuna: yellowfin, skipjack, albacore, bigeye, tongol, northern bluefin, southern bluefin and bonito. Of these species, only albacore can be labeled "white tuna" when canned in the United States. The remaining seven species are all sold in the United States labeled "light tuna."

Despite these complexities, some inferences can be made. Slightly less than half of the world's canned tuna is yellowfin, and together yellowfin tuna and skipjack tuna account for about 96 percent of the world's canned tuna (Monterey Bay Aquarium 2003). Thus, if you are eating light tuna, the odds are that you are eating yellowfin or skipjack. Yellowfin is significantly larger than skipjack tuna and, accordingly, generally higher in mercury content.

Mercury Content as a Function of Fishing Method

Factors that may strongly affect the mecury content of canned tuna are the size and age of the fish and, by association, the fishing method by which it was caught. Although tuna is caught by a number of methods, two methods, longlining and purse seining, account for the great majority of tuna available in U.S. markets. Both are industrial-scale methods fine-tuned to catch the largest

Table 1: U.S. Supply of Canned Tuna, 1994-2004 (canned weight, thousands of pounds)

Year	*U.S.-Packed Supply		Imports		Total
1994†	601,123	71%	249,043	29%	850,166
1995	659,196	75%	215,365	25%	874,561
1996	665,950	78%	193,037	22%	858,987
1997	617,065	74%	212,171	26%	829,236
1998	671,541	74%	240,409	26%	911,950
1999	685,871	67%	334,537	33%	1,020,408
2000	667,163	68%	312,967	32%	980,130
2001	503,879	63%	292,202	37%	796,081
2002	543,381	59%	378,140	41%	921,521
2003	523,047	53%	459,029	47%	982,076
2004	431,000	49%	443,297	51%	874,297

Source: NMFS 2005. Fisheries of the United States 2004, p 72.

†The 1994 data is from NMFS 2004. Fisheries of the United States 2003, p 78.

*These figures represent the total U.S. supply of U.S.-packed tuna minus the small percentage of exported tuna.

amount of fish possible. Although it is extremely difficult to know exactly where and how canned tuna was caught, much less how large the tuna was, the predominance of these two methods makes it possible to draw reasonable inferences about the tuna in a can based on the country where it was processed (also called the "country of origin") and the species of tuna.

Longlining: As the name suggests, longline fishing involves the deployment of central fishing lines of tremendous length, up to 50 miles or more for a single line. Each of these central lines is strung with many smaller lines, each bearing a baited hook. Consequently, a single longline vessel can deploy thousands of hooks at a time.

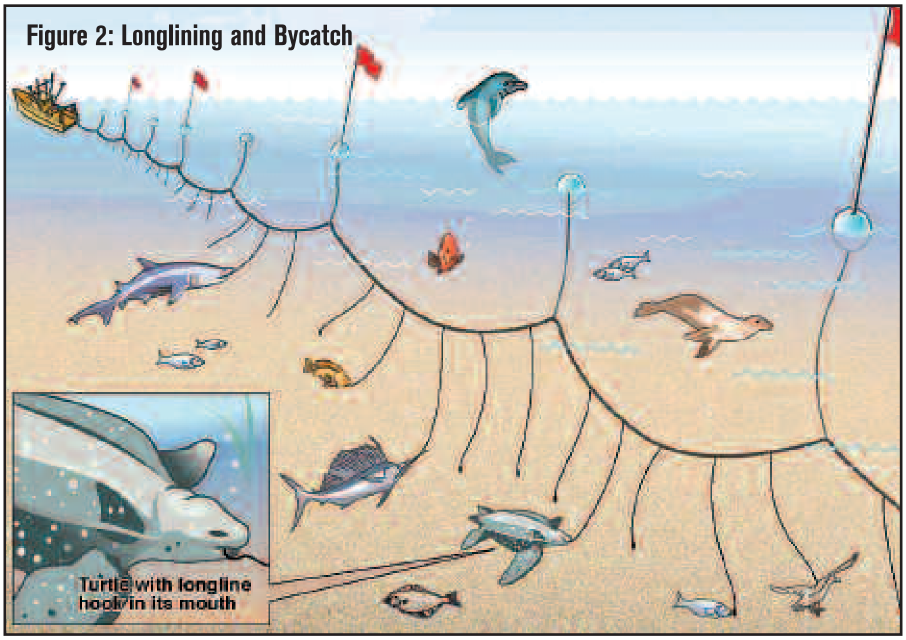
Longliners catch a wide array of tuna—from juveniles to adults. Large tuna, which are relatively intact when brought on board, are usually sold to the Asian sushi market, where they fetch the highest price (FAO 2005). Smaller fish caught by longliners are more likely to end up in canned tuna. Thus, it can be inferred that canned tuna caught by longliners are likely to have lower mercury levels than the larger fish provided to the sushi market. Asian countries such as Taiwan and Japan typically use longliners to catch the bulk of their tuna.

An unfortunate consequence of longlining is that it catches more than just tuna. Thousands of other "non-target" marine species are also attracted by the baited hooks and caught incidentally as "bycatch" (see Figure 2). It is estimated that more than 300,000 endangered sea turtles (Lewison 2004), 300,000 seabirds (BirdLife International 2004) and tens of millions of sharks (United Nations Environment Programme 2004) are caught and killed in longlines each year.

Purse Seining: Like longlining, purse-seine fishing is a large-scale industrial fishing method designed to catch huge numbers of fish at a time. Rather than a long line of baited hooks, purse seiners deploy nets up to a mile long. Small speed boats are launched from the main fishing boat to surround the fish with netting. Everything in the path of the boats gets encircled and corralled in the large net (see Figure 3). The bottom of the net is then pulled closed like a drawstring purse to catch the tuna, mostly yellowfin and skipjack, which is subsequently canned.

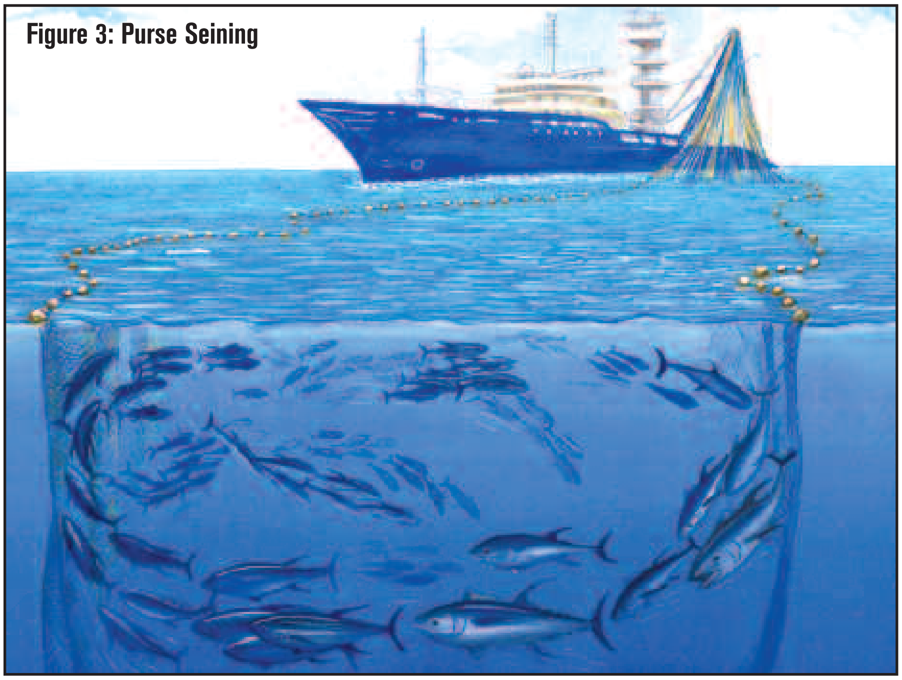
SOURCE: WWW.SEATURTLES.ORG

Figure 2: Longlining and Bycatch



SOURCE: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Figure 3: Purse Seining



Longlining and purse seining are the two large-scale, industrial fishing methods commonly used to catch tuna. Unfortunately, both techniques also snare and kill large numbers of sharks, dolphins, sea turtles and other marine wildlife each year.

While an efficient way to catch tuna, purse seining also results in high levels of bycatch, which includes dolphins, sharks, sea turtles and other marine wildlife that swim with or near the tuna. Purse seining has proved particularly deadly for dolphins. In the eastern tropical Pacific Ocean, large, mature yellowfin tuna often swim below pods of dolphins. Some fishermen intentionally chase and net the dolphins in purse-seine nets to catch the tuna swimming below. Since the late 1950s, more than seven million dolphins have been killed this way.

In 1990, widespread public opposition to this practice led the U.S. Congress to prohibit U.S. fishing vessels from intentionally setting nets on dolphins and to create a dolphin-safe tuna-labeling program to allow consumers to make informed choices about how the tuna they buy is caught.

Despite the U.S. dolphin-safe labeling program and the development of international standards to reduce intentional sets on dolphins, a small number of countries, such as Ecuador, Mexico and Venezuela, continue to catch dolphins while purse seining for tuna. Within the United States, it is illegal to label tuna dolphin-safe if it is caught by intentionally setting purse-seine nets on dolphins; however, it is still legal to sell non-dolphin-safe tuna in the United States, i.e., tuna without the dolphin-safe label.

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Hawksbill sea turtles and other air-breathing marine animals get entangled in purse-seine nets and drown.

Because only older, faster tuna are capable of keeping up with dolphins, tuna caught in purse-seine nets set on dolphins are primarily large, mature yellowfin tuna. These fish tend to be much larger than tuna caught by other fishing methods. Given the strong correlation between the size and age of a fish and its mercury content, they are also likely to be contaminated with higher levels of mercury than smaller, younger tuna caught by dolphin-safe methods. This, coupled with the larger size of yellowfin compared to skipjack, may be one reason for the higher concentrations of mercury reported for the yellowfin. Moreover, unlike large tuna caught on longlines, big yellowfin caught in purse-seine netting operations do not remain intact and end up as canned tuna, rather than sushi.

Purse seines are also used to catch tuna without targeting dolphins, but these sets also net large amounts of bycatch. Purse-seine operations use "fish aggregating devices" (FADs), which attract tuna but also draw large numbers of sharks, juvenile tuna and sometimes sea turtles that are then caught in the tuna nets. Thus, purse seining, even when dolphin-safe, takes a heavy toll on non-target species such as sharks, sea turtles and juvenile tuna.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Dolphin- and Human-Safe: The Link Between Mercury and the Dolphin-Safe Label

Purse-seine nets are the nets made infamous by the dolphin-safe tuna controversy. For more than a decade, Defenders of Wildlife has fought to ensure that the dolphin-safe label is applied only when no dolphins were intentionally chased or netted in the process of tuna fishing. In recent years, the Bush administration has been trying to weaken the strong dolphin-safe definition by allowing tuna caught in intentional dolphin sets to be labeled dolphin-safe. The results of our own research suggest that, in addition to harming dolphins, this watering down of the dolphin-safe label might also expose consumers to increased health risks due to mercury exposure.

III. PUBLIC HEALTH WARNINGS ON FISH CONSUMPTION

To reduce the risk of damaging effects from methylmercury, pregnant women, infants, children and women of childbearing age are encouraged to limit consumption of fish that may contain high levels of mercury. For instance, it is better to avoid large, predatory fish such as tuna and swordfish in favor of smaller fish that are lower on the food chain. However, opinions differ on just how much mercury, if any, can be consumed safely and how much of which fish can be eaten without exceeding that allowable dose. In addition, it is difficult to get detailed, accurate information on the mercury concentrations in specific types of fish, particularly tuna.

To date, 45 states and several Native American tribes have issued advisories or guidance to educate the public on how to avoid the harmful effects of mercury-contaminated fish (EPA 2004). Most of these advisories are targeted at fishermen eating their own catch, rather than consumers, but 11 states specifically warn pregnant women and children to limit their consumption of canned tuna.[4]

Hawaii, for instance, provides its residents with more protective advice than the federal government by recommending that adults limit their consumption of canned tuna to six ounces (one can) per week and children limit their consumption of canned tuna to three ounces (half a can) per week (Hawaii State Department of Health 2003). California has made the greatest strides toward educating the public on the risks of eating fish high in mercury. As a result of actions taken by the California attorney general, several grocery stores and restaurant chains are now posting warnings on the health risks of eating fish with mercury (including tuna) in their businesses.[5] At the national level, the U.S. Food and Drug Administration (FDA) and the EPA also offer advice on mercury in fish.

However, despite the broad array of advisories and the wide body of knowledge on the subject, the majority of the public remains unaware of the government's advice and of actual impacts mercury-contaminated fish can have on them and their children (Burger 2005). Even most people who are aware of the government's advice on fish consumption are unable to remember which fish are low mercury and which to avoid (Oceana 2005).

Not only is the advice consumers receive about fish consumption not adequately publicized, it is also often inconsistent, varying not only from state to state, but also between the states and the federal government. More troubling is that our evidence suggests that the federal advice most broadly distributed to the most vulnerable populations does not tell the complete story. Combined with federal programs that actively promote increased tuna consumption, this advice may be putting many women and children at additional and unnecessary risk from mercury exposure.

Federal Advice on Mercury in Fish

The EPA and FDA both bear some responsibility for determining what levels of mercury, if any, are safe for the members of our society most vulnerable to mercury poisoning—namely infants, children, pregnant women and women of childbearing age. In the past, the two agencies used different operational definitions of levels of mercury in fish that could lead to unsafe exposure. The agencies also issued separate and inconsistent dietary advisories, largely because of their differing jurisdictions. As part of its responsibility for regulating and protecting water quality in the United States, the EPA advises states on the safety of consuming locally and recreationally caught fish consumption. By contrast, the FDA is responsible for the safety of commercial seafood. Despite these differing jurisdictions, it is clear that the toxin involved (methylmercury), the means of exposure (ingestion) and the ensuing health risks are the same regardless of whether the fish involved are caught in a local stream or on the high seas. Thus, after many years of contradictory recommendations, the FDA and EPA released a Joint Advisory in 2004 in an attempt to harmonize their previously inconsistent guidance.

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Even low levels of mercury can harm developing fetuses.

EPA's Reference Dose: Science-Based Protection

The EPA has a well-established, science-based level for its recommended maximum mercury intake limit. The EPA defines its "reference dose" (RfD) for mercury as "an amount of methylmercury, which when ingested daily over a lifetime is anticipated to be without adverse health effects to humans, including sensitive populations" (EPA 1997). At or below this dose, exposures are expected to be safe.

As the basis for its reference dose, the EPA began with the level of mercury in fetal (umbilical cord) blood known to cause clearly observed adverse effects on brain development in children. The EPA then incorporated a tenfold "uncertainty factor" between this dose and the RfD. In other words, the RfD is designed to keep mercury levels in fetal blood at least 10 times lower than the dose at which adverse effects were evident. This margin is called an "uncertainty factor" because there are, in fact, substantial scientific uncertainties about where the line is, or if there even is a line, between doses that cause some harm and doses that do not. Sensitivity to mercury poisoning may vary from one part of the population to the next or even from one person to the next. Just as importantly, a dose that causes no observable effects on one aspect of human health may have unexpected health impacts in other areas. Because of these uncertainties, exposure above the RfD (but still below the known harmful level) is not necessarily harmful, exposure below the RfD is not necessarily free of all risk. The EPA states that the "risk following exposures above the [reference dose] is uncertain, but risk increases as exposures to methylmercury increase" (EPA 1997).

In 1997, the EPA set the reference dose at 0.1 micrograms of mercury per kilogram of body weight per day (μg/kg/day). In doing so, the EPA strove to ensure that the RfD, with its incorporated uncertainty factor, defined an exposure level that should pose no significant risk to the developing fetus. In an independent study conducted in 2000, the National Research Council determined that the EPA reference dose was scientifically sound and should continue to be used as the guideline for protecting public health. Two years later, the European Commission adopted the EPA's reference dose for the European Union as well, declaring that the commission "consider[s] the U.S. EPA RfD of 0.1 μg per kg body weight a day to be appropriate for Europe" (European Commission 2002).

The EPA's reference dose recognizes that the impacts of mercury exposure vary widely depending on the age and size of the person, an important factor that can lead to substantial differences in the relative vulnerabilities of different parts of the population. The RfD is expressed in micrograms of mercury per unit of body weight per day, so the more you weigh, the higher your RfD. Since the EPA's reference dose increases proportionately based on an individual's weight, the RfD inherently has a stricter standard built in for smaller children who are more susceptible to the damaging neurological effects of mercury.

Sensitivity to mercury poisoning may vary from one part of the population to the next or even from one person to the next.

Unfortunately, emerging evidence suggests that even the EPA reference dose may not fully protect developing fetuses. The EPA reference dose was designed to prevent women of child-bearing age and pregnant women from exceeding blood mercury concentrations of 5.8 mg/L on the assumption that the mercury concentration in fetal blood would match that found in the blood of the mother. However, recent studies indicate that mercury levels in umbilical cord blood are actually 70 percent higher than mercury levels in the mother's blood (Mahaffey 2005; Stern 2005b). Therefore, to keep fetal blood below 5.8 mg/L, the appropriate target level for maternal blood actually needs to be below 3.5 mg/L (5.8/1.7), as opposed to the 5.8 mg/L on which the current reference dose is calculated. Thus, protecting the developing fetus requires maternal blood mercury levels much lower than previously thought. In light of this evidence, there is reason to believe that the reference dose should be lowered to better protect developing fetuses. Moreover, as previously noted, recent studies suggest that even lower levels of mercury exposure may contribute to heart attack risk and cause other adverse health effects among the general population.

Absent more restrictive federal guidance, however, the EPA's reference dose remains the best available science-based definition of an allowable level of mercury intake.

Mercury is the often-secret ingredient in an American lunchtime favorite: the tuna-salad sandwich.

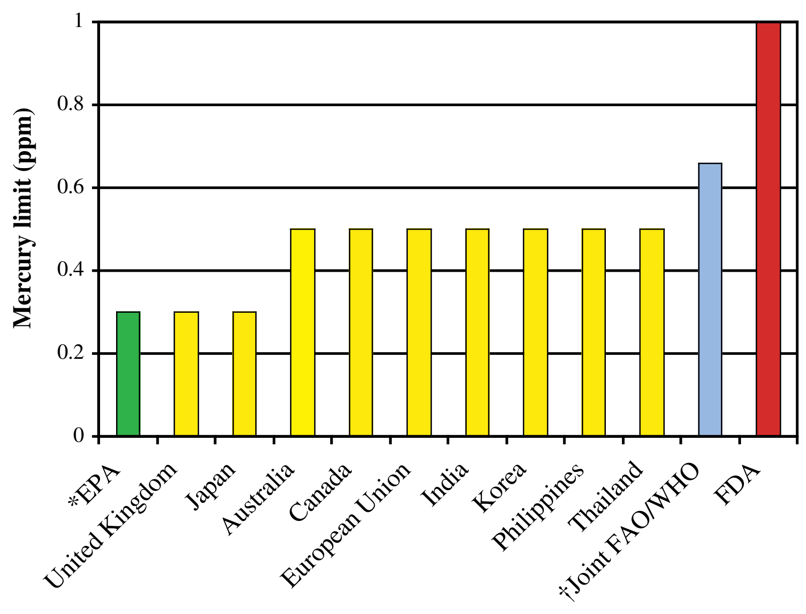
FDA's Action Level: An Ineffective Safety Net

A different and less precise indicator of a maximum permissible amount of mercury in tuna may be found in the "action level" set by the FDA. As the federal agency responsible for ensuring the safety of the nation's food supply, the FDA has set action levels for harmful contaminants, above which the agency can take legal action to remove products from store shelves to protect consumers. The action level for mercury in fish, shellfish, crustaceans and other aquatic animals (fresh frozen or processed) is 1.0 part per million (ppm) (FDA 2000). This limit was established in 1975, long before the evidence on which the EPA RfD is based was available. In fact, the FDA first set the action level at 0.5 ppm in 1969, but was forced to roll the limit back to 1.0 ppm in response to an industry lawsuit. As might be expected, the action level therefore is substantially higher than the concentrations that would cause a typical consumer to exceed the EPA reference dose. Even a single serving of fish containing 1.0 ppm of mercury can deliver much more than the EPA reference dose to the person eating it. For example, a 140-pound woman who eats a single six-ounce can of tuna with a mercury concentration of 1.0 ppm consumes roughly four times the EPA's weekly reference dose for mercury. A 45-pound child eating the same can of tuna would consume more than 10 times the reference dose.

The FDA action level is among the least protective mercury guidelines adopted by any developed country or international health body (see Figure 4) and has been criticized by the National Academy of Sciences (NAS) and others as insufficient to safeguard the health of children and fetuses (NAS 1991). As we shall see, however, our random testing of canned tuna showed that tuna exceeding the action level is common on supermarket shelves, suggesting that the FDA's current monitoring and enforcement efforts are at best woefully inadequate. The NAS reached the same conclusion, noting that even with the high 1.0 ppm action level, the "present monitoring and inspection program carried out by all federal agencies lacks both the frequency and the direction sufficient to ensure effective implementation of the nation's regulatory limits for seafood safety" (NAS 1991). In fact, the only enforcement of the 1.0 ppm action level uncovered by Defenders in researching this report occurred between 1991 and 1993, during which period eight enforcement incidents are recorded (FDA 1991; FDA 2006). The seafood (shark and swordfish) was recalled due to "excessive levels of methylmercury."[6] None of these enforcement actions involved the recall of tuna, however. Nearly 15 years after the NAS finding, it is clear that unknown quantities of canned tuna are entering U.S. markets without adequate (if any) screening for mercury. Most of this tuna seems to come from foreign sources that go completely unexamined.

Considering the findings of the NAS and the stricter protections seen worldwide, the FDA's action level needs to be significantly reduced to protect adequately against adverse effects on fetal development. At a minimum, the FDA should substantially increase its monitoring program and take stronger steps to keep tuna above the mercury action level off store shelves. As a regulatory safety net, the current action level is inadequate.

Figure 4: Maximum Allowed/Recommended Mercury Levels in Fish (ppm) in Selected Countries and by IGOs



*The 0.3ppm mercury limit was derived by applying the EPA RfD of 0.7 µg/kg/body weight to an adult weighing 155 pounds (70 kg) and consuming one six-ounce can of tuna per week. By the nature of the RfD, this number is variable and would increase for those weighing less than 155 pounds (and eating more tuna) and would decrease for those weighing more (and those eating less tuna).

† The Joint FAO/WHO Expert Committee on Food Additives (JECFA) recommends a tolerable weekly intake of 1.6 µg/kg/body weight per week and cautioned that children and fetuses might need even greater protection (JECFA 2003). To determine the 0.66ppm mercury limit, the 1.6 µg/kg/body weight standard was applied to a 155-pound person consuming one six-ounce can a week.

Government-issued guidelines on tuna consumption are publicized in brochures and other materials.

Joint FDA/EPA Advisory on Mercury in Fish

In March 2004, the EPA and FDA issued a Joint Advisory on mercury in fish to minimize the confusion caused by competing and inconsistent advice from two government agencies. The Joint Advisory has been widely distributed to pediatricians, obstetricians, midwives and school administrators and incorporated into other government educational materials such as the FDA’s *Food Safety at a Glance: How to Protect Yourself and Your Baby* (FDA 2005).

The Joint Advisory states that by following the three recommendations below, pregnant women, women of childbearing age and children “will receive the benefits of eating fish and shellfish and be confident that they have reduced their exposure to the harmful effects of mercury” (EPA and FDA 2004). Specifically, the Joint Advisory recommends that consumers:

1. Do not eat shark, swordfish, king mackerel or tilefish because they contain high levels of mercury.
2. Eat up to 12 ounces (two average meals) a week of a variety of fish and shellfish that are lower in mercury.
   - Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock and catfish.
     - Another commonly eaten fish, albacore (“white”) tuna, has more mercury than canned light tuna. Therefore, when choosing your two meals of fish and shellfish, you may eat up to six ounces (one average meal) of albacore tuna per week.
3. Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers and coastal areas. If no advice is available, eat up to six ounces (one average meal) per week of fish you catch from local waters, but do not consume any other fish during that week.

This advisory marks the first time that canned tuna has specifically been included in federal advice on mercury and seafood, warning children, nursing mothers and women of childbearing age to limit their intake of certain mercury-containing fish. The FDA/EPA Joint Advisory draws a sharp distinction, however, between more expensive albacore tuna and the cheaper chunk light tuna that comprises the bulk of the market (USDA 2004). The advisory recommends that sensitive populations should limit their consumption of albacore tuna to one six-ounce serving per week, but says it is safe to eat up to 12 ounces (two cans) a week of light tuna.

Many public health professionals and environmental groups have criticized the advisory for not being protective enough. In particular, the government’s Joint Advisory fails to ensure that all segments of the public will keep their mercury doses below the EPA’s science-based reference dose. As a result, the FDA/EPA Joint Advisory largely disregards a well-established level designed to protect the health of those most susceptible to mercury exposure (National Research Council 2000).

While the advisory recognizes the potential risks of eating albacore, it simultaneously downplays concerns about the less expensive light tuna that people eat far more often. The Joint Advisory fails to acknowledge that not all light tunas are created equal. Whereas, “white” tuna by law applies only to albacore tuna, the term light tuna can be used for any of the other species of tuna. By relying on overall average mercury levels and not differentiating the “light” category further, the advisory wrongly suggests that all forms of light tuna contain insignificant traces of mercury. In reality, the amount of mercury contained in any one sample of tuna depends on a variety of factors including the species of tuna, the ocean in which it was caught and the size of the fish. Little, if any, of this information is readily available to the consumer.

Moreover, the advisory does not adequately distinguish between the amounts adults should consume and the amounts safe for children. It simply states that parents should “follow these same recommendations when feeding fish and shellfish to your young child, but serve smaller portions.” This advice is unclear and needlessly vague. If the EPA reference dose had been more closely adhered to, the Joint Advisory would provide more specific (and scientifically precise) advice to parents based on a child’s weight. (Several environmental and health groups have taken this step by providing “mercury calculators” and other tools on their Web sites.) Finally, the advisory fails to mention that fresh tuna also contains high mercury levels, often significantly higher than canned tuna.[7]

IV. INDEPENDENT MERCURY TESTING

For nearly two decades, Defenders of Wildlife's research and advocacy with respect to tuna fisheries have focused on the impacts on dolphins and other marine wildlife. Because of the high levels of wildlife mortality associated with various tuna fishing methods, we have promoted measures that would reduce the threat to wildlife and give consumers the tools to make informed purchasing decisions.

Recognizing that different tuna fishing practices have different environmental impacts, Defenders has also long been interested in the correlation between fishing method and the size and species composition of the tuna caught. As evidence of mercury concentrations in predatory fish has mounted in recent years, we have become increasingly curious about these correlations as they relate to the mercury composition of the fish caught and, thus, human health. To investigate these potential connections further and to educate the public on the risks associated with mercury in tuna, Defenders conducted an experiment to assess the differences in mercury concentration across a wide spectrum of canned tuna.

The country of origin label on canned tuna can be a clue to its mercury content. Tuna from Latin America had the highest levels of all the imported tuna tested.

Methodology

For this report, Defenders collected a total of 164 cans of tuna from retailers around the United States, including California, Indiana, Kentucky, Maryland, Minnesota, Texas and Washington, D.C. To get a cross section of the sorts of tuna available to consumers, we bought tuna from national and regional chains, "mom-and-pop" groceries, convenience stores and corner markets in neighborhoods with large ethnic populations. Although our study included the major national brands that dominate retail shelves, we also sampled store brands, specialty brands and other lesser known brands that, while comprising a relatively smaller portion of the total U.S. market, may be widely consumed at a regional level or among particular populations.

The tested brands included:

- Albertson's
- Atun Real Fiesta Brand
- Atunsito
- Bumble Bee
- Calmex
- Cento
- Chicken of the Sea
- Cub Foods
- Dave's Ahi Tuna
- Dave's American
- Dolores
- El Dorado
- Fiesta Brand
- Flavorite
- Geisha
- Herdez Atun

A 550-pound tuna–the bigger the fish, the higher the mercury content.

- IGA
- Maz Atun
- Nair
- Natural Sea
- Pacifico Azul
- Polar All Natural
- Portside
- Progresso
- Safeway
- Sardimar
- Starkist
- Sunny Select
- Trader Joe's
- Tuny
- Van Triunfo
- Western Family
- Whole Foods

Due to the rise in imported canned tuna and variations in mercury content according to the fishing method used, a range of canned tuna from several different fishing nations was tested. Sampled cans originated in Costa Rica, Ecuador, Malaysia, Mexico, the Philippines, Thailand and the United States. When considering the "country of origin" of each can, it was assumed that the country indicated on the label was the country of origin. The country was often indicated by a phrase such as "Product of Thailand" or a similar statement on the label. It should be noted that the country of origin shown on the label is generally the country where the tuna was canned, which may or may not be the country where or by whose vessels it was caught.

The 164 cans tested included:

- •10 American albacore tuna cans (four brands)
- •10 Asian albacore tuna cans (five brands)
- •25 American light tuna cans (five brands)
- •45 Asian light tuna cans (14 brands)
- •23 Costa Rican light tuna cans (two brands)
- •18 Ecuadorian light tuna cans (two brands)
- •33 Mexican light tuna cans (eight brands)

For purposes of regional comparisons, these samples break down to 35 American cans of tuna, 55 Asian cans and 74 cans from Latin America. The sample size was not intended to provide a representative sample of the U.S. tuna market, rather it was deliberately set to shine more light on the mercury content of foreign imports. U.S. brands, especially the three largest that make up the bulk of U.S. tuna, have already been the focus of much scrutiny and testing by the FDA and other groups, so we did not test as many of them.

Sample cans were submitted for mercury analysis to New Age/Landmark Mobile Laboratory Services in Benton Harbor, Michigan. New Age/Landmark is used by the Environmental Protection Agency and certified by the National Environmental Laboratory Accreditation Committee. To ensure the testing was blind, the first 100 cans were sent to the laboratory numbered 1 to 100 without their original labels. Using the same blind testing method, another 64 cans were sent to the same laboratory to confirm the initial results. Each label was removed and catalogued with the corresponding sample number and the place where the tuna can was purchased to ensure that the lab results could be matched with the corresponding label.

The laboratory tested each sample for the total mercury (both organic and inorganic) present in the tuna. Testing total mercury instead of methylmercury in fish is the method frequently used by the FDA when testing its own samples. This is a valid testing method because 90 percent to 99 percent of the total mercury in fish is in the form of methylmercury (Bloom 1992). The method, known as EPA Method SW-846 7473, involves controlled heating (to decompose the sample and separate the mercury from the solid tuna) and amalgamation (to isolate the mercury further and transform it into a measurable mercury vapor). The laboratory included blanks in every batch and employed other control methods to ensure accurate results. Dilution and recovery tests were also used as necessary to ensure the accuracy of the results.

Results of Independent Testing and Comparison to Government Testing

The recommendations in the 2004 EPA/FDA Joint Advisory are based on testing of tuna samples done by the FDA between 1991 and 2003. Although its testing data date back to at least 1991, the FDA stopped testing tuna for mercury in 1998 except for its annual "market basket" survey, only to restart again recently under pressure from scientists and environmental groups. A close review of the Joint Advisory and the FDA's underlying data indicate that the advisory is based on an analysis of 132 samples. Each sample tested was a composite of 12 cans, tested together, to give a cumulative average. The FDA's testing produced an average mercury level of 0.353 ppm in canned albacore (white) tuna and 0.118 ppm in canned light tuna (EPA and FDA 2006). While this testing method is valid and allows efficient testing of large quantities of tuna, it cannot determine the mercury dosage in any given can of tuna, and it "averages out" both high spikes and very low levels. In addition, the FDA's testing

Table 2: Breakdown of Results

	Average Hg* (ppm)	Median	Range
Albacore	0.401	0.400	0.170-.730
All Light Tunas	0.269	0.160	0.012-1.50
American Light	0.204	0.120	0.023-.990
Asian Light	0.073	0.052	0.012-.440
Costa Rica	0.281	0.230	0.079-1.30
Ecuador	0.754	0.680	0.300-1.50
Mexico	0.310	0.180	0.064-1.40
Overall Average	**0.285 ppm**	**0.180 ppm**	**0.012-1.50 ppm**

*Hg = Total Mercury

has focused almost exclusively on the three major U.S. brands, and has not, to our knowledge, specifically sampled the wider variety of brands and countries of origin that represent a growing part of the tuna market.

Our own testing of individual cans, focusing more heavily on foreign imports as opposed to domestic brands, produced much different results (see Table 2). The average mercury content in our albacore samples was 0.401 ppm, somewhat higher than the FDA's average, but within a reasonable range given our smaller sample size.

The more surprising results related to light tuna—the type of tuna most commonly consumed by the American public (see Table 3). The average mercury content in the 144 cans of light tuna sampled was 0.269 ppm, more than twice the 0.118-ppm average for light tuna reported by the FDA and well above FDA's 0.12 ppm cutoff for "low-mercury" fish. Indeed, nearly 60 percent of the cans we sampled exceeded that FDA average. Despite the general view that light tuna contains less mercury than white albacore tuna, our results showed that mercury levels in chunk light tuna, depending on its origin, can be as high as and, in some cases far higher than, those in albacore tuna (using the 0.353 ppm average found through FDA testing). In fact, some samples even surpassed the average levels in other species deemed by the FDA/EPA Joint Advisory as fish with the "highest levels of mercury" such as king mackerel (average: 0.73 ppm), swordfish (0.98 ppm), shark (0.99 ppm) and tilefish (1.45 ppm) (EPA and FDA 2004). Mercury levels in seven of the 144 samples of light tuna we tested either met or exceeded the FDA's action level of 1.00 ppm, indicating that as many as one out of every 20 cans of the light tuna we tested could warrant recall as unsafe for human consumption.

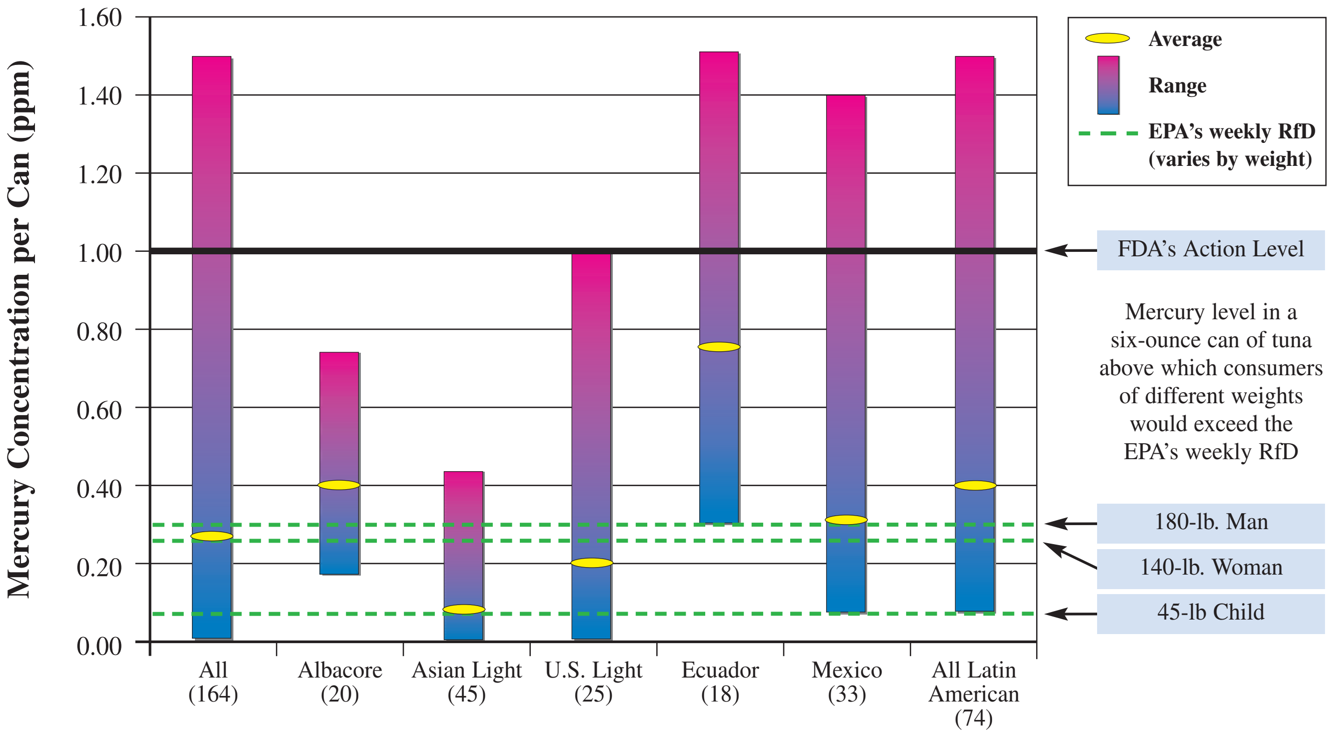
The overall average of all 164 cans we tested—albacore and light tuna combined—was 0.285 ppm, more than twice the FDA's "low mercury" cutoff level. More significant than these averages, however, is the high range of mercury concentrations, particularly in light tunas. Studies indicate that a single high dose of mercury (similar to those we found in some of the light tuna samples) may pose as much or greater

Table 3: Distribution of Mercury (Hg) Concentration in Canned Tuna by Type and Origin

		Low Hg	Medium Hg	High Hg		
	Total Samples	< 0.12 ppm*	0.12 - 0.3 ppm	0.3-0.5 ppm	0.5-0.9 ppm	> 0.9 ppm
ALBACORE	20 cans	0	5	12	3	0
		0	25%	60%	15%	0
LIGHT	144 cans	57	45	19	13	10
		40%	31%	13%	9%	7%
American light	25 cans	12	9	1	2	1
		48%	36%	4%	8%	4%
Light tuna from Asia	45 cans	39	5	1	0	0
		87%	11%	2%	0	0
ALL Latin American	74 cans	6	31	17	11	9
		8%	42%	23%	15%	12%
Ecuadoran	18 cans	0	0	6	6	6
		0%	0%	33%	33%	33%
Mexican	33 cans	5	16	6	4	2
		15%	48%	18%	12%	6%
Costa Rican	23 cans	1	15	5	1	1
		4%	65%	21%	4%	4%
ALL (Light and Albacore)	164 cans	57	50	31	16	10
		35%	30%	19%	10%	6%

*Fish containing less than 0.12 ppm are considered "low mercury" by the FDA.

Figure 5: Mercury Concentration in Canned Tuna by Country or Region of Origin



risk to developing fetuses and children as more sustained doses at lower levels (Ginsberg and Toal 2000). Thus, it is important not only to watch average intake, but also to avoid intake of individual cans with high mercury levels. Our data show potential for spike exposures from allegedly "low-mercury" fish—something the FDA might have missed by testing 12 cans at a time. Therefore, based on our results, there is serious cause for health concerns in eating canned tuna, regardless of whether it is albacore or chunk light.

Seventy percent of the cans Defenders tested contained enough mercury to put a 45-pound child over the reference dose with the consumption of just a single can in a week. Given the average level in all the cans we tested, a single six-ounce serving would exceed the RfD for a 140-pound woman and would contain more than three times the RfD for a small child. For that child to stay below the reference dose, the can would have to contain less than 0.08 ppm of mercury—yet only a quarter of the 164 cans had mercury levels that low. If the child ate two cans (12 ounces) or slightly less, which the vaguely worded Joint Advisory implies would be appropriate, he or she would exceed the reference dose unless the cans had less than 0.04 ppm of mercury. Ninety percent of the samples we tested exceeded that level. If the same child ate six ounces of albacore plus an additional can of light tuna, which the advisory also suggests is fine, he or she would be at even greater risk and even further over the RfD.

Our tests found that one out of every six cans tested had mercury above 0.5 ppm, and one of every 16 cans was over 0.9 ppm, with many of these at or above the FDA action level of 1.00 ppm. Statistics from some regions are even more troubling. For example more than a quarter (27 percent) of all light tuna tested from Latin America had mercury concentrations above 0.5 ppm, and roughly one in eight cans tested (12 percent) had mercury levels above 0.9 ppm. Alarmingly, two-thirds of the Ecuadorian tuna samples were over 0.5 ppm and a third were at or above the FDA's action level. (For the breakdown of the results by individual samples, see Table 3 and the Appendices.)

Figure 5 shows the range and averages of tested canned tuna sorted by country or region of origin. The bold line at 1.00 ppm shows the FDA's action level, the level at which the FDA may pull products from shelves as unsafe for human consumption. The vertical bars show the range of mercury levels

Defenders tested domestic and imported canned tuna purchased at a variety of retail outlets across the country.

detected in samples by country, region and tuna type. Seven of the 164 cans actually exceeded the FDA's action level, and several were very close to that limit.

As discussed, however, the FDA action level is not a reliable indicator of whether tuna is safe to eat, particularly given the vastly greater vulnerability of some sectors of the population. A more relevant figure in this respect is the EPA reference dose—the dose below which the EPA generally considers acceptable levels of exposure based on body size. The yellow horizontal bars in Figure 5 show the average mercury level in cans from each country or region. The dashed green lines show the mercury levels at which a representative consumer would exceed the EPA reference dose of mercury by eating a single, six ounce can of tuna per week: 0.31 ppm for a 180-pound man; 0.26 ppm for a 140-pound woman; 0.08 ppm for a 45-pound child.

Thus, a 180-pound man could eat one "average" can of tuna from our sample per week without exceeding EPA's reference dose. By contrast, that same average can of tuna would give a 140-pound woman a dose slightly above the EPA reference dose and expose a small child to a dose three times greater than the reference dose.

High mercury levels were most prevalent in Latin American tunas. Anyone, even a 180-pound man, consuming these products would substantially exceed the EPA RfD with only a single can. Remarkably, of the 18 cans tested from Ecuador, even the least contaminated met or exceeded this reference dose. The average can of tuna from Ecuador contained more than twice the EPA reference dose for an adult man and nearly 10 times the reference dose for a small child.

The green lines in Figure 5 showing the EPA's recommended weekly limit for individuals of varying weight indicate that one single can of the tuna we tested would put most Americans over the EPA RfD. If consumers were to follow the FDA's advice of two cans a week, they would be exposed to even higher (and riskier) doses of mercury.

Latin American Light Tuna: Unacceptably High Mercury Levels

Although all of the Latin American countries had tuna with much higher mercury concentrations than the FDA has previously attributed to light tuna, on average, light tuna originating from Ecuadorian fishing fleets had the highest level of mercury, with an average concentration of 0.754 parts per million (ppm). This exceeds average mercury concentrations for king mackerel, which is on the FDA and EPA's short list of high-mercury fish that women of child-bearing age, pregnant and nursing mothers and children should avoid. In addition, one third of the Ecuadorian tuna tested had levels over 0.91 ppm, with the highest reaching a level of 1.50 ppm—well above the FDA action level. If a 140-pound woman were to eat two cans of light tuna per week, as the advisory suggests, these samples would expose her to more than six times her weekly reference dose of mercury.

Mexican and Costa Rican tuna also had high average levels of mercury (0.310 ppm and 0.281 ppm, respectively) significantly higher than the sampled U.S. light tuna (0.204 ppm) and more than twice the average mercury concentration for light tuna reported by the FDA (0.118 ppm). In fact, the averages for our light tuna originating from Mexico and Costa Rica are very close to the average mercury levels of albacore tuna the FDA found in their own testing, which led the FDA and EPA to categorize albacore separately in the Joint Advisory. Ecuador's average, and individual samples from Mexico and Costa Rica far surpass albacore's average. The combined average mercury concentration for the Latin American tuna (0.409 ppm) also surpasses the average the FDA found for albacore.

Does Dolphin-Safe Fishing Affect Mercury Levels in Tuna?

Why are the results from Ecuador and Mexico so high? One reason may be that their fishing practices favor larger, older tuna caught in association with dolphins. While even the most conscientious consumer will find it difficult to decipher exactly how their canned tuna was caught, the country of origin label combined with the information from the International Dolphin Conservation Program (IDCP) offers some clues.

One of the world's largest tuna fisheries lies in the eastern Pacific Ocean. Vessels from all over the globe travel thousands of miles to fish for tuna in this region using purse seines, longlines and other fishing gear. In addition to being one of the largest tuna fishing grounds, the eastern Pacific has the unique distinction of being the only area where large schools of mature yellowfin tuna consistently swim together with pods of dolphins. For this reason, the eastern Pacific has long been at the center of the dolphin-safe tuna controversy and the focus of international attention on the effects of tuna fishing on dolphins and other wildlife. Because the tuna caught in association with dolphins are generally the oldest and largest fish—the fish most likely to have the highest levels of mercury—the eastern Pacific fishery has potential implications not only for wildlife, but also for humans.

Fishermen targeting mature yellowfin use large purse-seine vessels to chase and net dolphins and tuna. Ecuador and Mexico have the largest purse-seine fleets in the eastern Pacific, with 89 Ecuadorian vessels and 74 Mexican vessels, according to the 2006 vessel registry of the Inter-American Tropical Tuna Commission (IATTC). Venezuela has the next highest with only 25 vessels. Mexico and Ecuador also had the highest number of weeks at sea (IDCP 2002) and the highest catches of purse-seine caught tuna in the eastern Pacific Ocean in 2004 (IATTC 2005). While there are other methods of catching tuna that do not involve dolphins, it is well known that vessels from Ecuador and Mexico routinely set nets on dolphins to catch the mature yellowfin swimming below.

As a result of pressure to conserve dolphin stocks in the eastern Pacific, an international observer program was created under the International Dolphin Conservation Program to monitor fishing activities. To minimize the adverse impacts on dolphins, each large purse-seine vessel is required to have an observer on board for every trip and to submit weekly reports to the IATTC, the international forum that manages this fishery.

In 2004, Ecuador and Mexico, each of which has a long history of opposition to dolphin-safe standards and fishing practices, submitted only 44 percent and 30 percent of their weekly reports respectively. With observer reports for less than half of their weeks at sea, Mexico and Ecuador led the fishery for the most weeks at sea without observer reports on dolphin mortality (Ecuador: 755 weeks; Mexico: 594 weeks). With so many weeks at sea and such a poor reporting record, there is plenty of room for unreported dolphin mortality and other illegal fishing operations. Without observer reports it is also difficult to assess just how much of the Ecuadorian and Mexican tuna was caught in association with dolphins, but it can be inferred that at least some portion of the tuna from these countries is not dolphin-safe.

Even with the spotty reporting records, both Ecuador and Mexico had recorded violations of the IDCP. In 2002, three Ecuadorian vessels had six recorded IDCP violations, including three instances of using explosives, which are commonly used to herd dolphins and tuna into nets. Also in 2002, 13 Mexican vessels had 33 infractions, including four instances of observer harassment and attempted bribery, six instances of fishing at night (when it is difficult to see if dolphins are stuck in the net) and one instance of using explosives (IDCP 2002).

The number of Mexican and Ecuadorian purse-seine vessels operating in the eastern Pacific, their repeated violations of dolphin conservation measures, and the links between these violations and prohibited fishing methods related to dolphin encirclement strongly suggest that disproportionate numbers of tuna-fishing expeditions from these countries may involve illegal dolphin sets. In June 2002, for example, a Colombian vessel associated with an Ecuadorian tuna company was captured while fishing illegally for tuna in Galapagos National Park. The vessel, which was fishing without the required observer and without dolphin protection equipment, had 70 dead or injured dolphins in its nets (Reuters 2002). It is reasonable to assume that the tuna being caught in such sets is of the large, mature variety most often associated with dolphins. These are also the tuna most likely to contain the highest concentra-

Vessels from Ecuador and Mexico routinely set nets on dolphins to catch the mature yellowfin swimming below.

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Purse-seine nets set on dolphins target large, mature tuna–the fish most likely to have the highest levels of mercury.

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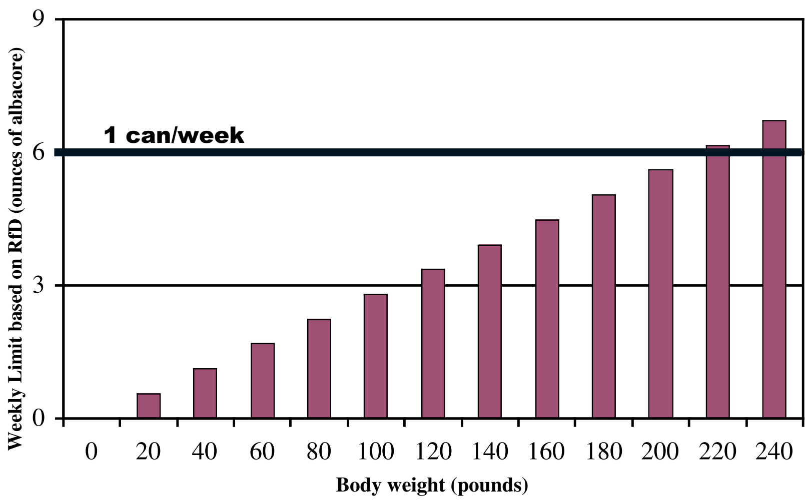
Yellowfin tuna is a high-mercury fish and a species that often ends up canned and marketed as "light tuna."

tions of mercury in their bodies. This would be consistent with the higher mercury concentrations we found in tuna processed in Ecuador and Mexico.

In 2002, the Bush administration issued a finding that would allow tuna from Mexico and other nations to be labeled "dolphin-safe" even if dolphins were intentionally chased and netted, provided that an on-board observer did not actually witness dolphins being killed or seriously injured. This also would have allowed vessels to mix dolphin-safe tuna and dolphin-deadly tuna on-board, rendering the dolphin-safe label essentially meaningless. A coalition of conservation groups, including Defenders, sued to stop the new rule from taking effect and, in August 2004, a federal judge overruled the administration and ordered the Commerce Department to issue a new rule prohibiting the use of the dolphin-safe label on tuna caught by setting nets on dolphins. The administration has appealed the ruling. If this Bush administration rule is ever actually implemented, consumers will have little way of knowing whether tuna bearing a government-approved, dolphin-safe label is truly dolphin-safe. Based on the results of our research, this watering down of the dolphin-safe label might also expose consumers to increased health risks from mercury contamination.

Figure 6: Maximum Weekly Consumption of Albacore Tuna (0.401 ppm) That Does Not Exceed the EPA Reference Dose (RfD) for People of Different Weights



Not All American "Light" Tuna is "Low Mercury"

Further drawing the "low-mercury" designation of light tuna into question is the fact that even the American light tuna that we tested had an average mercury level of 0.204 ppm, which is higher than the FDA's average for light tuna (0.118 ppm). While this higher average may be an artifact of our smaller sample size, it is nonetheless surprising given that our sample included five separate brands and multiple varieties acquired in several states. It is further evidence that the variation of mercury levels within and among brands warrants closer examination and that the blanket categorization of all light tuna as "low-mercury fish" needs to be revisited.

Albacore: Still a Risky Choice

The average mercury concentration in the albacore tuna Defenders tested was consistent with previous test results indicating that it contains relatively high levels of mercury. Our average (0.401 ppm) was slightly above the FDA's average for albacore (0.353 ppm) (EPA and FDA 2006).

As with light tuna, Defenders' testing found that even limiting consumption to one six-ounce can a week of albacore tuna does not adequately protect some populations when the EPA's reference dose is taken into account. Indeed, the FDA/EPA Joint Advisory's limit of six ounces of albacore per week offer adequate protection only if you weigh more than 220 pounds.

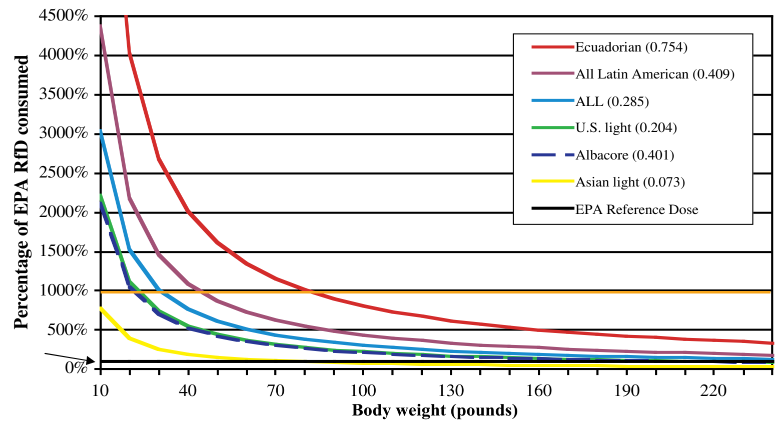
Figure 6 shows the amount of albacore people of varying body weights could regularly eat and stay within the EPA's reference dose if the tuna has the average mercury concentration found in the cans we tested. The Joint Advisory recommends that people limit their albacore consumption to six ounces (one can) a week, but also allows an additional six ounces of "low-mercury fish," which could include light tuna. Adding another can of light tuna would further increase mercury exposure, even assuming the person consumed no other mercury-contaminated fish during the week.

Comparison to Government Advice

Defenders' test data clearly show that sensitive populations, including pregnant women and children, who follow the government's Joint Advisory, could easily and often ingest doses of mercury far above the RfD. The advisory reassures the public that it is safe to eat up to 12 ounces of light tuna, or six ounces of albacore and six ounces of another type of fish, which could include light tuna. However, these amounts will expose sensitive populations to mercury levels much higher than levels regarded as "safe" by the government. Unless a person weighs more than 180 pounds, which most children and women do not, following the government's advice will put an individual over the RfD each week, even if he or she sticks to lower-mercury U.S. tuna.

Consumers who follow the Joint Advisory would be exposed to mercury levels well above the reference dose by

Figure 7: Percentages of EPA Reference Dose Consumed by People of Different Weights Following Government Tuna Guidelines



Following the FDA's tuna consumption advice would put most women and children well above the EPA's recommended maximum mercury intake level.

Figure 7 shows just how high above the EPA's scientifically derived maximum allowable level a person's mercury dose would be if he or she consumed two cans (12 ounces) of light tuna per week with the average mercury levels we found for each region or country. The graph compares the weight of the consumer (horizontal axis) to the mercury dose consumed relative to the EPA reference dose (vertical axis) depending on the origin of the tuna (colored lines). Doses are expressed as percentages of the EPA RfD; numbers greater than 100 percent indicate excessive exposure. The black line on the graph at 100 percent shows the EPA's reference dose, and the orange line at 1,000 percent shows the level at which adverse health effects have been measured in studied populations. For albacore, the chart was adjusted to account for the EPA/FDA advice limiting albacore consumption to six ounces per week, as opposed to 12 ounces.

eating all types of tuna we tested (see Figure 7), and some individuals would get doses associated with clearly adverse health effects (more than 10 times the RfD). For example:

- Any person following the government's advice that it is safe to eat 12 ounces (two cans) of light tuna each week would exceed their reference dose for mercury unless they weighed more than 300 pounds.
- Twelve ounces of U.S. light tuna at the average level we found would put anyone under 215 pounds over the RfD.
- A 140-pound woman who eats two cans of light tuna with the average mercury level found in our tests would ingest 218 percent of the safe dose (RfD).
- A child weighing 45 pounds eating just one average can of light tuna from our study would get a dose of mercury more than three times (339 percent) as high as the EPA recommends in a week and a dose 896 percent (nine times) as high if they ate one can of Ecuadorian tuna in a week.
- To eat the same amount of Latin American tuna and stay within the RfD, a person would have to weigh more than 440 pounds. In

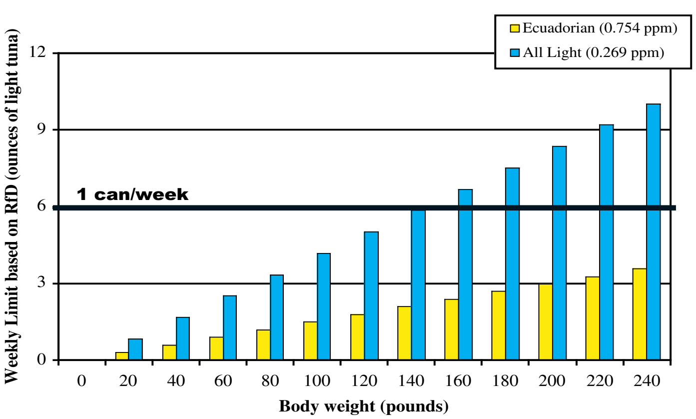
Although mercury levels in tuna vary across regions and countries, the FDA based its tuna consumption recommendations on testing that focused on major domestic brands.

particular, two cans of Ecuadorian tuna, given the Ecuadorian average of 0.75 ppm, would exceed the reference dose for anyone weighing less than 800 pounds and would give a 140-pound woman a dose nearly six times more than her RfD for the week.

- For a child or small adult weighing 80 pounds or less, the dose from two cans of the Ecuadorian tuna in our sample would be at least 10 times greater than the RfD—a dose that has been found to have clear adverse effects in epidemiological studies.
- For the albacore we tested, even the more protective advice of only consuming six ounces of albacore a week is not protective enough. Anyone weighing less than 215 pounds would still exceed the reference dose with one six-ounce can.
- Asian tuna fared the best of all, with levels low enough to keep most adults safe even with the recommended two cans per week, but still too high for children less than 75 pounds.

Figure 8 shows the maximum amount of tuna, based on our test results, people of varying weights could eat each week without exceeding the RfD. As the graph shows, the great majority of consumers would need to eat significantly less than 12 ounces (two cans) of tuna per week to stay below their reference dose. For many women, and nearly all children, even one can per week may be too much.

Figure 8: Maximum Weekly Consumption of Canned Light Tuna That Will Not Exceed The EPA Reference Dose (RfD) for People of Different Weights



A Disproportionate Impact on Poor and Minority Communities?

Our results indicate that low-income and underprivileged communities may be disproportionately affected by high levels of mercury in tuna. By basing its advice about tuna on the average mercury level found in the FDA's testing—which has focused on major domestic brands—it is likely that the government failed to take into account the variation in mercury levels across regions and countries—and how these differences may affect consumers. The breadth of foreign imports and the possibility of higher mercury levels in foreign tuna is a factor that has largely been overlooked. With foreign imports now composing more than half of the market share of the entire U.S. tuna supply (NMFS 2005), this oversight must be remedied.

In collecting our samples, we found that tuna from Latin American sources was more likely to be available in minority communities. Although awareness of the Joint Advisory is limited throughout the country, poor, minority and non-English speaking communities are likely to have even less access to public health information than the public at large. For this reason, many

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people buying Latin American tuna may not be aware of the health risks from mercury in tuna. At the same time, many of these same consumers may be drawn to Latin American tuna by the Spanish label and the association of a particular brand with their own country or culture. In most cases, we found that the familiar Latin American brand names were bolstered by being the cheapest variety available in many locations.

Compounding the risk for poor and minority communities is the fact that, while the federal government warns pregnant women, nursing mothers and children against consuming too much tuna with one hand, it encourages them to eat tuna with the other. This can be very confusing for women who are trying to do the right thing for their babies and themselves. In some cases, the government is even promoting tuna consumption by subsidizing the purchase of tuna specifically by a group particularly at risk: nursing mothers.

The federal government funds a food-assistance program called the Special Supplemental Nutrition Program for Women, Infants and Children, better known as the WIC Program. WIC is designed to reach and help low-income, nutritionally at-risk women and their babies. Nearly 8 million women, infants and children get WIC benefits each month, including approximately 45 percent of infants born in America (USDA 2005b). One worrying aspect of the WIC program, however, is that nursing mothers, one of the most sensitive populations that the EPA/FDA advisory specifically targets, are eligible to receive canned albacore and light tuna through WIC vouchers.[8] These women are eligible to receive the tuna throughout the first year of their infant's life, a particularly critical time for brain development. With no other source of animal protein available through WIC, it is very likely that women will buy tuna and potentially expose their infants (via breast milk), as well as any other children they have, to unhealthy levels of mercury.

In addition to being promoted through the WIC program, tuna is distributed to more than 29 million children at qualifying schools throughout the country through the National School Lunch Program, further adding to the problem (USDA 2005a; USDA 2004). The program served more than 5 billion meals to children in 2004, an average of 500 million meals each month during the school year (USDA 2005a). This included more than 2,370,000 pounds of canned and pouched tuna in 2004 (USDA 2004). These figures suggest that the amount of tuna consumed by the average child as part of a school lunch program each year is relatively modest. For most children, however, these programs will be only one among many sources of tuna in their diets—particularly if their families also participate in WIC or similar government assistance programs.

Beyond any doubt, the WIC and school lunch programs make an invaluable contribution to meeting the essential nutritional needs of many women, children and families in this country. Yet the well-intentioned policy of promoting tuna to nursing mothers and young children may also be doing the large portion of our society that depends on these programs a serious disservice.

All of these factors, combined with our finding of excessively high levels of mercury in Latin American tuna, point toward a potential public health threat to poor and minority communities that is being largely overlooked.

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Canned tuna is the sole source of animal protein available through the government's most popular food-assistance program for nutritionally at-risk women and children.

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Tuna is also distributed to qualifying schools through the National School Lunch Program. The amount consumed by students under this program is modest but may be only one of the sources of tuna in their diets.

V. KEY FINDINGS AND RECOMMENDATIONS

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Government action is urgently needed to make America's favorite fish family-safe. Meanwhile, women and children would do well to avoid canned tuna, especially Latin American brands.

On the basis of our research, we believe that members of sensitive populations, and the public at large, can exceed the safe dose for mercury by wide margins if they consume even modest portions of tuna. Our results are in stark contrast to the average mercury level for light tuna reported by the government—and used as the basis for its mercury advice. The mercury levels revealed in our own tests of light tuna were closer, on average, to the higher levels found in albacore. In some cases, mercury concentrations approached those found in high-mercury species, such as king mackerel, shark and swordfish, which are subject to far more stringent recommendations against consumption.

The concentration of mercury in tuna can vary widely as a result of several variables, including fish size, species and ocean of origin. It is also likely that the amount of mercury is a function of the fishing method used (determining the size and the species of the tuna caught). As it currently stands, the permissible level recommended in the Joint Advisory is putting the American public, and sensitive populations and low-income communities in particular, at increased risk of unacceptable mercury exposure. By only focusing on an average sample of mostly American-processed tuna, the FDA and EPA are ignoring a large and growing market of foreign and specialty tunas that may contain higher levels of mercury. With levels as high as we found in some types of tuna, the FDA/EPA advisory is inadequate, misleading and fails to protect the health of many Americans. Our research suggests this risk will be greatest among low-income and at-risk populations in which tuna is readily available and actively promoted as an inexpensive and beneficial protein source.

We believe that our test results showing high levels of mercury in light tuna point toward a broader public health problem that should be addressed with further testing and more restrictive recommendations. It has been five years since the National Academy of Science reviewed the EPA's reference dose and deemed that it was an appropriate limit to use for protecting public health based on the best scientific knowledge at the time. Since then, the science linking mercury contamination to adverse health impacts has improved, further reinforcing this assessment and bolstering the argument for stricter advice on fish consumption—more closely linked to the EPA RfD—to protect the public from harm. The current Joint Advisory falls far short of achieving that goal. This shortfall is compounded by the FDA's persistent failure to establish and meaningfully enforce a stricter action limit to keep high mercury tuna off store shelves and its failure to extend its Hazard Analysis and Critical Control Point (HACCP) guidance for seafood processors to include methylmercury. As it stands, the FDA's HACCP guidance neglects to offer the seafood industry advice on controls that could be used to improve the safety of fish and fails to acknowledge methylmercury as a hazard reasonably likely to occur (GAO 2001; FDA 2001).

These failures are unacceptable and should be remedied in a way that gives greater weight to protecting the health of the American public. Therefore, we urge our government to take the following steps to protect consumers:

1. Conduct a more thorough assessment of the mercury content in canned tuna by looking at the growing market of imported canned tuna and paying greater attention to the higher mercury levels found in Latin American varieties.

2. Issue warnings for canned light tuna equivalent to those for albacore tuna (six ounces per week maximum) until the FDA can conduct more comprehensive tests on imported tuna. Advise parents to limit their children's consumption of canned tuna to three ounces (half a can) or less per week. This would better protect vulnerable populations and serve as a responsible model for state advisories.

3. Reassess the role of canned light tuna in government food-support programs such as WIC and the federal school lunch program.

4. Effectively enforce the FDA's 1.00 ppm action level for the sale and importation of canned tuna and other fish with excessive levels of mercury. In addition, update and extend the FDA's Hazard Analysis and Critical Control Point (HACCP) guidelines to recognize mercury as a likely hazard and require seafood industry controls to monitor for high mercury content in fish.

5. Investigate the potential link between environmentally destructive dolphin 'sets' and mercury concentrations.

In conclusion, it is the government's duty to make America's favorite fish family-safe and provide consumers with the information they need to make informed choices. The government should keep canned tuna with excessive mercury off the market and give consumers clear and well-researched advice on tuna consumption to protect us from unacceptable exposure to mercury—regardless of where we live or what kind of tuna we can afford.

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Further investigation of the link between purse-seine operations that set their nets on dolphins and high-mercury tuna is urgently needed.

APPENDIX A

Results by Mercury Concentration (Albacore and Light)

#	Brand	Country	Type	ppm
1	Tuna Real	Ecuador	Solid pack in oil	1.500
2	Calmex	Mexico	Light	1.400
3	Tuna Real	Ecuador	Solid pack in oil	1.400
4	Sardimar	Costa Rica	Light	1.300
5	Tuna Real	Ecuador	Solid pack in oil	1.200
6	Tuna Real	Ecuador	Solid pack in oil	1.200
7	Maz Atun	Mexico	Light tuna (yellowfin)	1.000
8	Dave's Ahi Tuna	U.S.	Ahi, hook-and-line caught	0.990
9	Tuna Real	Ecuador	Solid pack in oil	0.980
10	Tuna Real	Ecuador	Solid pack in oil	0.910
11	Dave's Ahi Tuna	U.S.	Ahi, hook-and-line caught	0.790
12	Van Triunfo	Ecuador	Fancy solid in oil	0.760
13	Whole Foods	Thailand	Albacore, solid white	0.730
14	Tuna Real	Ecuador	Solid pack in oil	0.720
15	Starkist	U.S.	Albacore, solid white	0.710
16	Tuna Real	Ecuador	Solid pack in oil	0.700
17	Tuna Real	Ecuador	Solid pack in oil	0.660
18	Tuny	Mexico	Light tuna (yellowfin)	0.640
19	Dolores	Mexico	Light in water	0.630
20	Starkist	U.S.	Albacore, solid white	0.590
21	Progresso	U.S.	Light in olive oil	0.580
22	Tuny	Mexico	Light tuna (yellowfin)	0.570
23	Van Triunfo	Ecuador	Fancy solid in oil	0.570
24	Tuna Real	Ecuador	Solid pack in oil	0.550
25	Sardimar	Costa Rica	Light in oil	0.500
26	Tuny	Mexico	Light tuna (yellowfin)	0.500
27	Dave's Gourmet Albacore	U.S.	Albacore fillets, line-caught	0.490
28	Tuna Real	Ecuador	Solid pack in oil	0.490
29	Bumble Bee	U.S.	Albacore: solid white	0.460
30	Dave's gourmet albacore	U.S.	Albacore fillets, line-caught	0.460
31	Tuna Real	Ecuador	Solid pack in oil	0.450
32	Tuna Real	Ecuador	Solid pack in oil	0.450
33	Nair	Mexico	Light tuna (yellowfin)	0.440
34	Polar All Natural	Thailand	Albacore, solid white	0.440

35	Sunny Select	Thailand	Light tuna in water	0.440
36	Polar All Natural	Thailand	Albacore, solid white	0.430
37	Tuny	Mexico	Light tuna (yellowfin)	0.420
38	IGA	Thailand	Albacore, solid white in water	0.410
39	Dave's American	U.S.	Albacore, Pacific Gourmet	0.400
40	IGA	Thailand	Albacore, solid white in water	0.400
41	Atunsito	Mexico	Light tuna (yellowfin)	0.380
42	Dave's American	U.S.	Albacore: Pacific Gourmet	0.380
43	Dolores	Mexico	Light tuna (yellowfin)	0.380
44	Van Triunfo	Ecuador	Fancy solid in oil	0.380
45	Geisha	Malaysia	Albacore, solid white in water	0.370
46	Pacifico Azul	Costa Rica	Light in water	0.370
47	Tuna Real	Ecuador	Light in oil	0.360
48	Dave's Ahi Tuna	U.S.	Ahi, hook-and-line-caught	0.350
49	Sardimar	Costa Rica	Light with garbanzo	0.350
50	Atunsito	Mexico	Light tuna (yellowfin)	0.340
51	Sardimar	Costa Rica	Light with garbanzo	0.340
52	Maz Atun	Mexico	Light tuna (yellowfin)	0.320
53	Pacifico Azul	Costa Rica	Light with veggies	0.320
54	Dave's Gourmet Albacore	U.S.	Albacore fillets, line-caught	0.310
55	Pacifico Azul	Costa Rica	Light	0.310
56	Trader Joe's	Thailand	Albacore, solid white in water	0.300
57	Van Triunfo	Ecuador	Fancy solid in oil	0.300
58	Chicken of the Sea	U.S.	Albacore, chunk white in water	0.290
59	Geisha	Malaysia	Albacore, solid white in water	0.290
60	Sardimar	Costa Rica	Light with corn	0.270
61	Dave's Ahi Tuna	U.S.	Ahi, hook-and-line-caught	0.260
62	Dolores	Mexico	Light in water	0.260
63	Pacifico Azul	Costa Rica	Light with veggies	0.250
64	Progresso	U.S.	Light in oil	0.250
65	Sardimar	Costa Rica	Light in water	0.250
66	Sardimar	Costa Rica	Light in water	0.250
67	El Dorado	Mexico	Light tuna (yellowfin)	0.230
68	El Dorado	Mexico	Light tuna (yellowfin)	0.230
69	Pacifico Azul	Costa Rica	Light with veggies	0.230
70	Chicken of the Sea	U.S.	Light in oil	0.220
71	Whole Foods	Thailand	Albacore, solid white	0.220

72	Bumble Bee	U.S.	Light in water	0.210
73	Dolores	Mexico	Light tuna (yellowfin)	0.210
74	Sardimar	Costa Rica	Light with jalapenos	0.210
75	Bumble Bee	U.S.	Light in water	0.200
76	Sardimar	Costa Rica	Light in water	0.200
77	Starkist	U.S.	Light in water	0.190
78	Starkist	U.S.	Light in water	0.190
79	Calmex	Mexico	Light in oil	0.180
80	Dave's Ahi Tuna	U.S.	Ahi, hook-and-line-caught	0.180
81	Dolores	Mexico	Light tuna (yellowfin)	0.180
82	Flavorite	Thailand	Light in water	0.180
83	Flavorite	Thailand	Light in water	0.180
84	Flavorite	Thailand	Light in water	0.180
85	Pacifico Azul	Costa Rica	Light with veggies	0.180
86	Calmex	Mexico	Light w/ jalapeno	0.170
87	Chicken of the Sea	U.S.	Albacore in water	0.170
88	Pacifico Azul	Costa Rica	Light w/ veggies	0.170
89	Trader Joe's	Thailand	Albacore, solid white in water	0.170
90	Dolores	Mexico	Light in water	0.160
91	Dolores	Mexico	Light in oil (yellowfin)	0.160
92	Flavorite	Thailand	Light in water	0.160
93	Pacifico Azul	Costa Rica	Light with jalapeno	0.160
94	Pacifico Azul	Costa Rica	Light with jalapeno	0.160
95	Pacifico Azul	Costa Rica	Light with jalapeno	0.150
96	Dolores	Mexico	Light (yellowfin) w/ veggies	0.150
97	Herdez Atun	Mexico	Light (yellowfin) in oil	0.150
98	Pacifico Azul	Costa Rica	Light with jalapenos	0.150
99	Calmex	Mexico	Light in oil	0.140
100	Dolores	Mexico	Light in water	0.140
101	Tuny	Mexico	Light (yellowfin) in water	0.140
102	Sunny Select	Thailand	Light in water	0.130
103	Pacifico Azul	Costa Rica	Light with veggies	0.130
104	Pacifico Azul	Costa Rica	Light with jalapenos	0.130
105	Tuny	Mexico	Light (yellowfin) in oil	0.130
106	Bumble Bee	U.S.	Light in water	0.120
107	Tuny	Mexico	Light (yellowfin) in oil	0.120
108	Dolores	Mexico	Light (yellowfin) in water	0.110

109	Dolores	Mexico	Light (yellowfin) in water	0.110
110	Albertson's	Thailand	Light in water	0.100
111	Albertson's	Thailand	Light in water	0.100
112	Tuny	Mexico	Light (yellowfin) in water	0.100
113	Cento	Thailand	Light in olive oil ("tonno")	0.093
114	IGA	Thailand	Light in water	0.085
115	Whole Foods	Thailand	Light (tongol)	0.085
116	Tuny	Mexico	Light (yellowfin) in oil	0.084
117	Western Family	Thailand	Light in water	0.083
118	Safeway	Thailand	Light in water	0.083
119	Cento	Thailand	Light in olive oil ("tonno")	0.082
120	Whole Foods	Thailand	Light (tongol)	0.081
121	Sardimar	Costa Rica	Light with corn	0.079
122	Cento	Thailand	Light in olive oil ("tonno")	0.078
123	Starkist	U.S.	Light in oil	0.076
124	Safeway	Thailand	Light in water	0.069
125	Calmex	Mexico	Light with jalapenos	0.064
126	Starkist	U.S.	Light in water	0.063
127	Natural Sea	Thailand	Light in water	0.061
128	Chicken of the Sea	U.S.	Light in water	0.060
129	IGA	Thailand	Light in water	0.059
130	Sunny Select	Thailand	Light in water	0.054
131	Natural Sea	Thailand	Light in water	0.053
132	Chicken of the Sea	U.S.	Light in water	0.052
133	Natural Sea	Thailand	Light in water	0.052
134	Natural Sea	Thailand	Light in water	0.052
135	Western Family	Thailand	Light in oil	0.051
136	Starkist	U.S.	Light in water	0.050
137	Safeway	Thailand	Light in water	0.050
138	Portside	Thailand	Light in water	0.049
139	Whole Foods	Thailand	Light (tongol)	0.049
140	Starkist	U.S.	Light in oil	0.048
141	Bumble Bee	U.S.	Light with lemon	0.048
142	Natural Sea	Thailand	Light in water	0.048
143	Cub Foods	Thailand	Light in water	0.047
144	Chicken of the Sea	U.S.	Light in oil	0.046
145	Western Family	Thailand	Light in oil	0.043

146	Sunny Select	Thailand	Light in water	0.042
147	Starkist	U.S.	Light in water	0.042
148	Starkist	U.S.	Light in water	0.037
149	Starkist	U.S.	Light in water	0.036
150	Albertson's	Thailand	Light in water	0.035
151	Cub Foods	Thailand	Light in water	0.035
152	Fiesta Brand	Philippines	Light in water	0.035
153	Natural Sea	Thailand	Light in water	0.035
154	Albertson's	Thailand	Light in water	0.034
155	Western Family	Thailand	Light in oil	0.034
156	Fiesta Brand	Philippines	Light in water	0.034
157	Portside	Thailand	Light in water	0.029
158	Fiesta Brand	Philippines	Light in water	0.025
159	Portside	Thailand	Light in water	0.025
160	Bumble Bee	U.S.	Light with lemon	0.023
161	Trader Joe's	Thailand	Light in water (tongol)	0.017
162	Trader Joe's	Thailand	Light in water (tongol)	0.014
163	Trader Joe's	Thailand	Light in water (tongol)	0.012
164	Trader Joe's	Thailand	Light in water (tongol)	0.012

Results by Country of Origin (Light Tuna)

#	Brand	Country	Type	ppm
1	Sardimar	Costa Rica	Light	1.300
2	Sardimar	Costa Rica	Light in oil	0.500
3	Pacifico Azul	Costa Rica	Light in water	0.370
4	Sardimar	Costa Rica	Light with garbanzo	0.350
5	Sardimar	Costa Rica	Light with garbanzo	0.340
6	Pacifico Azul	Costa Rica	Light with veggies	0.320
7	Pacifico Azul	Costa Rica	Light	0.310
8	Sardimar	Costa Rica	Light with corn	0.270
9	Pacifico Azul	Costa Rica	Light with veggies	0.250
10	Sardimar	Costa Rica	Light in water	0.250
11	Sardimar	Costa Rica	Light in water	0.250
12	Pacifico Azul	Costa Rica	Light with veggies	0.230
13	Sardimar	Costa Rica	Light with jalapenos	0.210
14	Sardimar	Costa Rica	Light in water	0.200
15	Pacifico Azul	Costa Rica	Light with veggies	0.180
16	Pacifico Azul	Costa Rica	Light with veggies	0.170
17	Pacifico Azul	Costa Rica	Light with jalapeno	0.160
18	Pacifico Azul	Costa Rica	Light with jalapeno	0.160
19	Pacifico Azul	Costa Rica	Light with jalapeno	0.150
20	Pacifico Azul	Costa Rica	Light with jalapenos	0.150
21	Pacifico Azul	Costa Rica	Light with jalapenos	0.130
22	Pacifico Azul	Costa Rica	Light with veggies	0.130
23	Sardimar	Costa Rica	Light with corn	0.079
24	Tuna Real	Ecuador	Light in oil	1.500
25	Tuna Real	Ecuador	Light in oil	1.400
26	Tuna Real	Ecuador	Light in oil	1.200
27	Tuna Real	Ecuador	Light in oil	1.200
28	Tuna Real	Ecuador	Light in oil	0.980
29	Tuna Real	Ecuador	Light in oil	0.910
30	Van Triunfo	Ecuador	Light in oil	0.760
31	Tuna Real	Ecuador	Light in oil	0.720
32	Tuna Real	Ecuador	Light in oil	0.700
33	Tuna Real	Ecuador	Light in oil	0.660
34	Van Triunfo	Ecuador	Light in oil	0.570

35	Tuna Real	Ecuador	Light in oil	0.550
36	Tuna Real	Ecuador	Light in oil	0.490
37	Tuna Real	Ecuador	Light in oil	0.450
38	Tuna Real	Ecuador	Light in oil	0.450
39	Van Triunfo	Ecuador	Light in oil	0.380
40	Tuna Real	Ecuador	Light in oil	0.360
41	Van Triunfo	Ecuador	Light in oil	0.300
42	Calmex	Mexico	Light	1.400
43	Maz Atun	Mexico	Light tuna (yellowfin)	1.000
44	Tuny	Mexico	Light tuna (yellowfin)	0.640
45	Dolores	Mexico	Light in water	0.630
46	Tuny	Mexico	Light tuna (yellowfin)	0.570
47	Tuny	Mexico	Light tuna (yellowfin)	0.500
48	Nair	Mexico	Light tuna (yellowfin)	0.440
49	Tuny	Mexico	Light tuna (yellowfin)	0.420
50	Atunsito	Mexico	Light tuna (yellowfin)	0.380
51	Dolores	Mexico	Light tuna (yellowfin)	0.380
52	Atunsito	Mexico	Light tuna (yellowfin)	0.340
53	Maz Atun	Mexico	Light tuna (yellowfin)	0.320
54	Dolores	Mexico	Light in water	0.260
55	El Dorado	Mexico	Light tuna (yellowfin)	0.230
56	El Dorado	Mexico	Light tuna (yellowfin)	0.230
57	Dolores	Mexico	Light tuna (yellowfin)	0.210
58	Calmex	Mexico	Light in oil	0.180
59	Dolores	Mexico	Light tuna (yellowfin)	0.180
60	Calmex	Mexico	Light w/ jalapeno	0.170
61	Dolores	Mexico	Light in oil (yellowfin)	0.160
62	Dolores	Mexico	Light in water	0.160
63	Dolores	Mexico	Light (yellowfin) w/veggies	0.150
64	Herdez Atun	Mexico	Light (yellowfin) in oil	0.150
65	Calmex	Mexico	Light in oil	0.140
66	Dolores	Mexico	Light in water	0.140
67	Tuny	Mexico	Light (yellowfin) in water	0.140
68	Tuny	Mexico	Light (yellowfin) in oil	0.130
69	Tuny	Mexico	Light (yellowfin) in oil	0.120
70	Dolores	Mexico	Light (yellowfin) in water	0.110
71	Dolores	Mexico	Light (yellowfin) in water	0.110

72	Tuny	Mexico	Light (yellowfin) in water	0.100
73	Tuny	Mexico	Light (yellowfin) in oil	0.084
74	Calmex	Mexico	Light with jalapenos	0.064
75	Western Family	Philippines	Light in water	0.083
76	Western Family	Philippines	Light in oil	0.051
77	Western Family	Philippines	Light in oil	0.043
78	Fiesta Brand	Philippines	Light in water	0.035
79	Western Family	Philippines	Light in oil	0.034
80	Fiesta Brand	Philippines	Light in water	0.034
81	Fiesta Brand	Philippines	Light in water	0.025
82	Sunny Select	Thailand	Light tuna in water	0.440
83	Flavorite	Thailand	Light in water	0.180
84	Flavorite	Thailand	Light in water	0.180
85	Flavorite	Thailand	Light in water	0.180
86	Flavorite	Thailand	Light in water	0.160
87	Sunny Select	Thailand	Light in water	0.130
88	Albertson's	Thailand	Light in water	0.100
89	Albertson's	Thailand	Light in water	0.100
90	Cento	Thailand	Light in olive oil ("tonno")	0.093
91	IGA	Thailand	Light in water	0.085
92	Whole Foods	Thailand	Light (tongol)	0.085
93	Safeway	Thailand	Light in water	0.083
94	Cento	Thailand	Light in olive oil ("tonno")	0.082
95	Whole Foods	Thailand	Light (tongol)	0.081
96	Cento	Thailand	Light in olive oil ("tonno")	0.078
97	Safeway	Thailand	Light in water	0.069
98	Natural Sea	Thailand	Light in water	0.061
99	IGA	Thailand	Light in water	0.059
100	Sunny Select	Thailand	Light in water	0.054
101	Natural Sea	Thailand	Light in water	0.053
102	Natural Sea	Thailand	Light in water	0.052
103	Natural Sea	Thailand	Light in water	0.052
104	Safeway	Thailand	Light in water	0.050
105	Portside	Thailand	Light in water	0.049
106	Whole Foods	Thailand	Light (tongol)	0.049
107	Natural Sea	Thailand	Light in water	0.048
108	Cub Foods	Thailand	Light in water	0.047

109	Sunny Select	Thailand	Light in water	0.042
110	Albertson's	Thailand	Light in water	0.035
111	Cub Foods	Thailand	Light in water	0.035
112	Natural Sea	Thailand	Light in water	0.035
113	Albertson's	Thailand	Light in water	0.034
114	Portside	Thailand	Light in water	0.029
115	Portside	Thailand	Light in water	0.025
116	Trader Joe's	Thailand	Light in water (tongol)	0.017
117	Trader Joe's	Thailand	Light in water (tongol)	0.014
118	Trader Joe's	Thailand	Light in water (tongol)	0.012
119	Trader Joe's	Thailand	Light in water (tongol)	0.012
120	Dave's Ahi Tuna	U.S.	Ahi, hook-and-line-caught	0.990
121	Dave's Ahi Tuna	U.S.	Ahi, hook-and-line-caught	0.790
122	Progresso	U.S.	Light in olive oil	0.580
123	Dave's Ahi Tuna	U.S.	Ahi, hook-and-line-caught	0.350
124	Dave's Ahi Tuna	U.S.	Ahi, hook-and-line-caught	0.260
125	Progresso	U.S.	Light in oil	0.250
126	Chicken of the Sea	U.S.	Light in oil	0.220
127	Bumble Bee	U.S.	Light in water	0.210
128	Bumble Bee	U.S.	Light in water	0.200
129	Starkist	U.S.	Light in water	0.190
130	Starkist	U.S.	Light in water	0.190
131	Dave's Ahi Tuna	U.S.	Ahi, hook-and-line-caught	0.180
132	Bumble Bee	U.S.	Light in water	0.120
133	Starkist	U.S.	Light in oil	0.076
134	Starkist	U.S.	Light in water	0.063
135	Chicken of the Sea	U.S.	Light in water	0.060
136	Chicken of the Sea	U.S.	Light in water	0.052
137	Starkist	U.S.	Light in water	0.050
138	Starkist	U.S.	Light in oil	0.048
139	Bumble Bee	U.S.	Light with lemon	0.048
140	Chicken of the Sea	U.S.	Light in oil	0.046
141	Starkist	U.S.	Light in water	0.042
142	Starkist	U.S.	Light in water	0.037
143	Starkist	U.S.	Light in water	0.036
144	Bumble Bee	U.S.	Light with lemon	0.023

Results by Country of Origin (Albacore)

#	Brand	Country of Origin	Type of Tuna	ppm
1	Starkist	U.S.	Albacore	0.710
2	Starkist	U.S.	Albacore	0.590
3	Dave's Gourmet Albacore	U.S.	Albacore	0.490
4	Bumble Bee	U.S.	Albacore	0.460
5	Dave's Gourmet Gourmet	U.S.	Albacore	0.460
6	Dave's American	U.S.	Albacore	0.400
7	Dave's American	U.S.	Albacore	0.380
8	Dave's Gourmet Albacore	U.S.	Albacore	0.310
9	Chicken of the Sea	U.S.	Albacore	0.290
10	Chicken of the Sea	U.S.	Albacore	0.170
11	Whole Foods	Thailand	Albacore	0.730
12	Polar All Natural	Thailand	Albacore	0.440
13	Polar All Natural	Thailand	Alabcore	0.430
14	IGA	Thailand	Albacore	0.410
15	IGA	Thailand	Albacore	0.400
16	Trader Joe's	Thailand	Albacore	0.300
17	Whole Foods	Thailand	Albacore	0.220
18	Trader Joe's	Thailand	Albacore	0.170
19	Geisha	Malaysia	Albacore	0.370
20	Geisha	Malaysia	Albacore	0.290

ENDNOTES

1. Humans are also exposed to mercury through dental amalgams, thimersol in vaccines, occupational releases for those working with mercury and through some cosmetics (UNEP Global Mercury Assessment. Section 4.2.1). The Global Mercury Assessment goes on to state that even though intake levels of inorganic and elemental mercury may be higher than methylmercury intakes, because of the high toxicity level of methylmercury it is still considered to "generally constitute the major adverse impact on humans from mercury compounds" (UNEP Global Mercury Assessment Section 4.3.1, 297).

2. While this process is primarily associated with the aquatic food chain, recent studies have also indicated that bioaccumulation of mercury may also act similarly in terrestrial ecosystems. "Biogeographical patterns of environmental mercury in northeastern North America." March 2005. Ecotoxicology. Volume 14 Numbers 2, 3.

3. In addition, close to 20 million Americans, including 6.2 million children, had asthma in 2003 (American Lung Association, Epidemiology and Statistics Unit, Research and Program Services. Trends in Asthma Morbidity and Mortality, May 2005).

4. States with mercury advisories specifically for tuna include: California, Connecticut, Hawaii, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, Washington and Wisconsin.

5. "Eateries Agree to Mercury Warnings," *Los Angeles Times*, February 5, 2005. www.latimes.com/business/la-fi-fish5feb05,1,5922326.story?coll=la-headlines-business

6. In a court finding from nearly 25 years ago, the court upheld that imported fish with mercury levels above 1.00 ppm posed a serious risk to public health, enjoined the suppliers from importing the dangerously contaminated fish. United States v. Anderson Seafoods, Inc., 622 F.2d 157 (5th Circuit 1980).

7. The Joint Advisory briefly addresses tuna steaks, but the advice is hidden in the question section rather than included in the advisory itself. The FDA and EPA recommend that "[b]ecause tuna steak generally contains higher levels of mercury than canned light tuna, when choosing your two meals of fish and shellfish, you may eat up to six ounces (one average meal) of tuna steak per week" (FDA/EPA 2004 advisory). While it is important to address excessive mercury levels in fresh tuna, this report focuses on canned tuna because it is consumed more frequently in the United States. It was beyond the scope of the report to test for mercury in fresh tuna as well.

8. Breastfeeding woman are authorized to buy up to 26 ounces of tuna per month (4.3 cans) through WIC. www.fns.usda.gov/wic/lawsandregulations/WICRegulations-7CFR246.pdf, p. 40.

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