

White Paper

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Analysis of the Sierra Club's Alarmist Claims about the Health Impacts of Mercury

Summary and Conclusion

The alarmists in some government agencies and their drivers among highly-funded special interest environmental groups such as the Sierra Club and Friends of the Earth offer no convincing scientific evidence that Americans face any real mercury-induced health threat from current fish consumption, while their own misinformation may seriously harm public health. Their sensationalized claims in the media are based on little more than questionable research, often non-transparent data sets and highly subjective and sensational interpretations. They appear to discount the most recent research findings, which strongly challenge their claims.

If these organizations were truly concerned with the health and welfare of women and children, they should apply their precautionary approach about the potential indication of harm, not the actual proof of it, to their own public mis-statements and regulatory zeal. Their proposed policy prescriptions would provide no benefits while inflicting enormous societal costs, especially for minorities, the elderly, the poor, women and children (see WHITE PAPER: EPA Mercury MACT Rulemaking not Justified by Science at www.scienceandpolicy.org). (See attachment: Testimony of Lee H. Walker.)

Most distressing, by invoking scientifically unjustified scenarios of mercury harm (seemingly without regarding the variety of mercury's chemical and biological forms), the Sierra Club appears culpable for contributing to popular alarmism, including Zero Mercury Campaign, "Out of Control and Close to Home," "Cycle of Harm," "Clean the Rain Campaign," which needlessly frighten women of childbearing age. This should be of particular concern to advocates for the health and welfare of women and children because the crucial dietary benefits of fish consumption are being needlessly jeopardized.

It is the science-challenged alarmists who are endangering the health of America's and the world's children.

Therefore, the public may reasonably conclude that the scientifically questionable accusations in paid advertisements and public policy initiatives by organizations such as the Sierra Club (Washington Post, January 20, 2004), Friends of the Earth (USA TODAY, March 16, 2004) and MoveOn.org (March 26, 2004's TV ad campaign) are likely politically and financially motivated.

We do not believe that there is presently good scientific evidence that moderate fish consumption is harmful to the fetus. However, fish is an important source of protein in many countries and large numbers of mothers round the world rely on fish for proper nutrition. Good maternal nutrition is essential to the baby's health. Additionally, there is increasing evidence that the nutrients in fish are important for brain development and perhaps for cardiac and brain function in older individuals. – Dr. Gary Meyers, (Pediatric Neurologist, University of Rochester)

Analysis & Commentary on Sierra Club Mercury Claims

(Washington Post, January 20, 2004)

Sierra Club: *“Mercury pollution is so toxic and widespread, 45 states have warned Americans not to eat fish – caught or canned – because of high mercury levels that can cause birth defects and learning disabilities. Already, five million American women of childbearing age have dangerous levels of mercury in their bodies, according to the Centers for Disease Control.”*

CSPP’s Comments:

(1) *“Mercury pollution is so toxic and widespread...”*

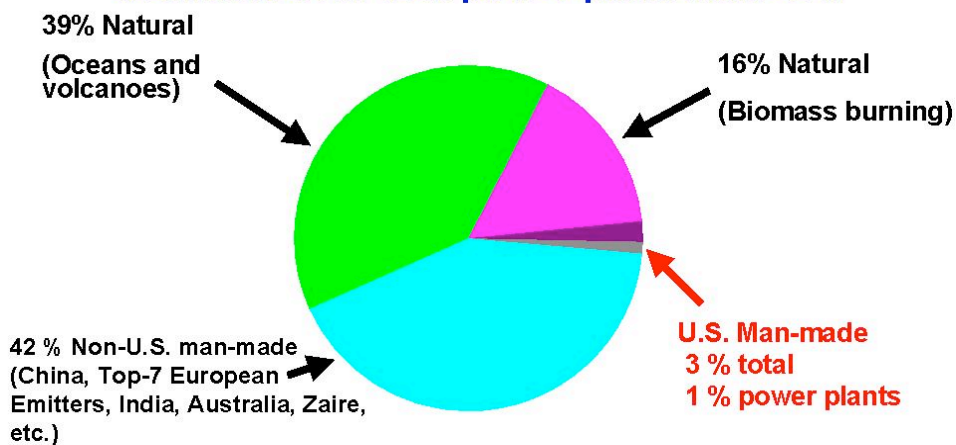
Tracking the flow of mercury, both man-released and natural, in the environment is an extremely complex and difficult scientific problem. Most of the mercury emitted from power plants and other industrial sources is able to spread quickly around the globe by air currents simply because the emitted mercury can reside in the atmosphere for as long as six months to two years. This is why the “mercury pollution” problem is generally considered by scientists to be a *global* issue that may truly require coordinated international solutions through broad-based prescriptions rather than through any particular local management or control.

In addition, natural sources of mercury emission, such as forest fires and volcanoes, often overshadow man-made sources. **Figure 1** makes clear that U.S. coal-powered plants cumulatively emit very little compared either to natural sources or other non-U.S. emitters. Indeed the U.S. EPA (2004, *Federal Register*, vol. 69 [no. 20], 4651-4752; found at <http://www.epa.gov/fedrgstr/EPA-AIR/2004/January/Day-30/a1539.htm>) noted that:

“[I]t is not possible to quantify how much of the methylmercury in fish consumed by the U.S. population is contributed by U.S. emissions relative to other sources of mercury (such as natural sources and re-emissions from the global pool). As a result, the relationship between Hg emission reductions from Utility Units and methylmercury concentrations in fish cannot be calculated in a quantitative manner with confidence. In addition, there is uncertainty regarding over what time period these changes would occur.” (p. 4658)

Figure 1

Mercury Emission from U.S. Power Plants: Only 1% of the world total emission and mercury releases from biomass burnings worldwide dominate over U.S. power-plant emission



Pacyna et al. 2003, Freidli et al. 2003

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(2) "...warned Americans not to eat fish – caught or canned..."

This is a *seriously misleading and irresponsible statement*. The health advisory by the FDA is not as extreme. The March 2001 FDA health advisory on methyl-mercury in fish (<http://www.cfsan.fda.gov/%7Edms/admehg.html>) simply advises pregnant women (and women who may become pregnant) to avoid eating large and long-lived species of fish such as shark, swordfish, king mackerel and tilefish that are known to contain high levels of methylmercury. However, this same group of women is also advised to consume a variety of other kinds of fish as part of a healthy diet (up to 12 ounces of cooked fish per week). This advisory appears reasonable and beneficial in the absence of any medically or scientifically sound epidemiological evidence of alleged "birth defects or learning disabilities" in American children through moderate fish consumption (see further discussion in CSPP's comment # 3).

EPA (2004, *Federal Register*, vol. 69 [no. 20], 4651-4752) affirms that "Fish consumption dominates the pathway for human and wildlife exposure to methylmercury. The typical U.S. consumer eating a wide variety of fish from restaurants and grocery stores is not in danger of consuming harmful levels of methylmercury from fish and is not advised to limit fish consumption."

The most recently issued (March 19, 2004) joint advisory on methylmercury in fish by EPA/FDA (<http://www.epa.gov/ost/fishadvice/advice.html>) was similar to the March 2001 FDA consumer advisory, providing only additional caution about tuna steaks and canned albacore tuna; these contain generally higher levels of mercury than canned light tuna. It is interesting to note that a January 15, 2004's version of the draft advisory

continues to state that all pregnant women and nursing mothers “can safely include tuna as part of [their] weekly fish consumption” (<http://www.fda.gov/ohrms/dockets/ac/03/briefing/4010b1.html>) — see TAB 3 for the file labeled “Revised Draft Advisory” dated 1/15/04), although this seemingly sensible recommendation has not made the cut for the final advisory only two months later.

Alaska state epidemiologist John Middaugh and Grace Egeland contend that: “Severely limiting consumption of fish and seafood may do more harm than good by reducing the consumption of health benefits and by increasing the consumption of alternative foods that have potential health risks” (*Science*, 1997, vol. 278, 1904-1905).

In testimony before the FDA Food Advisory Committee in April 2002, John Middaugh had this to say about the danger to public health created by ill-conceived fish advisories:

“There are well-known public health benefits from fish consumption. Fish provide high nutritional value, vitamins A, E and C, protein, energy, omega-3 fatty acids, monolipids, iron and zinc. Omega-3 fatty acids have proven benefits in preventing complications from diabetes, preventing coronary heart disease and atherosclerosis and preventing complications from arthritis, to name just a few. There are also major economic, cultural, spiritual and social benefits from subsistence practices.

“Experience in Alaska has documented adverse effects on public health and communities from fish advisories with subsequent abandonment of traditional diets. Alaska natives are experiencing a major increase in the prevalence of diabetes. Heart disease rates are increasing, and recent studies have documented vitamin A and D deficiencies.

“Advisories based upon risk assessment without consideration of well-established public health benefits of fish consumption have great potential to harm public health if reductions in fish consumption occur. We have special concerns over the impact of fish advisories for Alaskan natives and rural resident subsistence consumers who have few alternatives to fish. The public health harm caused by fish advisories has been well documented, especially in Canada. Fortunately, data from Alaska provide evidence that most, if not all, Alaskan exposures to methylmercury are below those of current concern, even applying conservative models.

“Finally, extensive international scientific investigation of Arctic contaminants under the Arctic Monitoring and Assessment Program of the International Arctic Science Council during the past eight years has led to the consensus Arctic recommendations that the health benefits of Arctic subsistence foods outweigh potential risks, and that local public health authorities need to take into account local information to craft dietary guidelines.

“In response to the national fish advisories of January 2001, the Alaska Division of Public Health engaged in extensive consultations with Alaska stakeholders. After reviewing all of the available evidence, the Division of Public Health issued consensus recommendations for fish consumption in Alaska. The most important difference from national advisories is the following: The Alaska Division of Public Health continues to strongly recommend that all Alaskans, including pregnant women, women who are breast-feeding, women of childbearing age, and young children continue unrestricted consumption of fish from Alaskan waters.

“The State does not support national advisory recommendations to restrict fish consumption to 12 oz per week, or the national advisory recommendations for pregnant women to restrict fish consumption to one meal per month.”

Also, the recently increased number of state fish advisories is more likely due to the increase in the *number of mercury measurements* in fish, not to the increase in levels of mercury in the fish or increased scientific evidence of harm through consumption of fish.

(3) “...because of high mercury levels that can cause birth defects and learning disabilities.”

The Sierra Club persists in the popular claim of clear evidence for adverse health effects on fetal neurodevelopment through fish consumption. This simply is not true. In fact, the latest report by scientists from the University of Rochester’s Medical School (Myers et al., 2003, *The Lancet*, vol. 361, 1686-1692), tracking a group of 643 Seychelles Island children from birth to 9 years of age finds no detectable risk from exposure of methylmercury through fish consumption by their mothers or themselves. These results are fully consistent with this research group’s earlier findings when the Seychelles children were examined at 6, 19, 29 and 60 months of age. This negative result of exposure risk is notable because the Seychelles Island population consumes 10 to 14 fish meals per week, far more than the one or fewer seafood meals per week consumed by average Americans. One would expect them to have correspondingly higher levels of exposure to methylmercury than do average Americans.

Rarely mentioned by special interest groups like the Sierra Club is that the Seychelles Island study suggests highly beneficial health improvements resulting from frequent fish consumption, such as the effects of selenium and vitamin E acting as anti-oxidants and omega-3 polyunsaturated fatty acids reducing risk of coronal heart disease.

On the basis of the most current and relevant scientific knowledge, it is unlikely that the Sierra Club, or any other special interest, is justified in claims about mercury harm through moderate consumption of fish by US populations.

The frequent claim of adverse neurodevelopmental harm to young children from exposure of methylmercury through fish consumption is based on unconfirmed and unresolved evidence from a study of Faroe Island children. **Figure 2** makes clear that at most, the evidence in that study is not clear. In fact, the authors of another paper observed that “Even though this outcome [the Boston Naming Test results] has the strongest mercury effect, the effect is seen to be quite small compared to the large residual variation” (Budtz-Jorgensen et al., 2003, *Environmetrics*, vol. 14, 105-120).

In addition, for the total of 17 neuropsychological tests conducted to search for association with prenatal exposure to mercury, only 3 tests yielded statistically significant correlations with maternal *cord blood* mercury concentration. *The statistical correlation for the same 3 test scores dramatically turned insignificant or marginally significant when the measured maternal hair mercury is adopted as the independent variable instead.*

Figure 2

Evidence for neuropsychological problems in the Faroe islands children study is weak

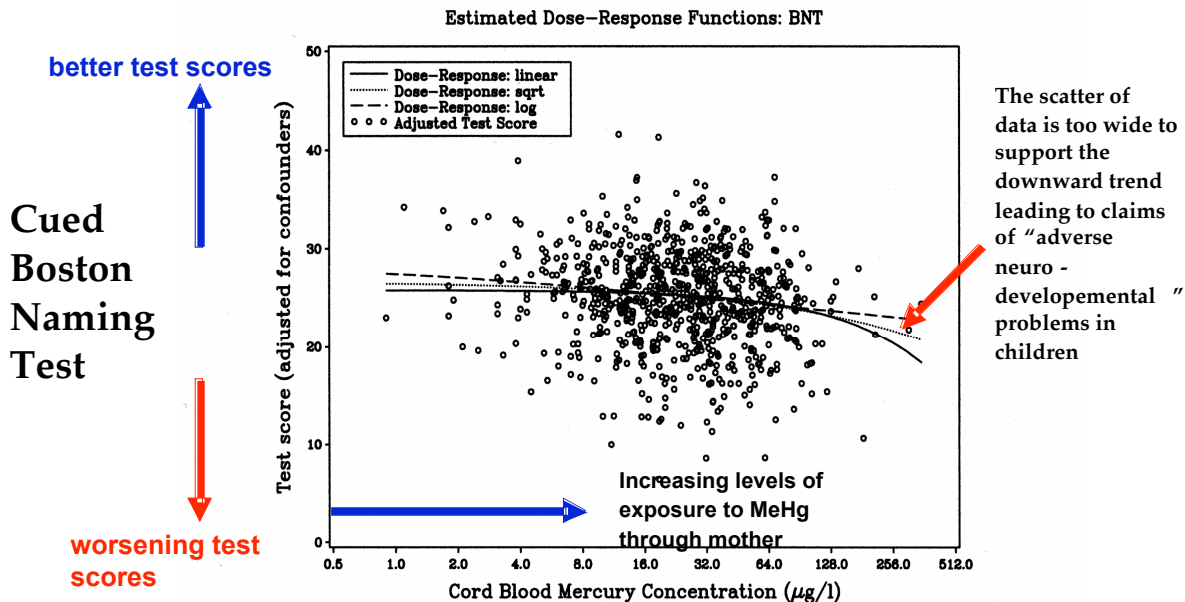


Figure 1: Partial residual plot of the relation between prenatal mercury exposure and the scores on the Cued Boston Naming Test.

Budtz-Jorgensen et al. (2003) *Environmetrics*, vol. 14, 105 -120

The authors of the Faroe Island study interpreted these differing results to suggest that maternal cord-blood must be a "better predictor of neurobehavioral toxicity" by methylmercury than maternal hair (see e.g., Budtz-Jorgensen et al., 2004, *Environmental Research*, "Association between mercury concentrations in blood and hair in methylmercury-exposed subjects at different ages", in press) because a claimed statistically significant and adverse effect was associated with cord-blood.

But a contrasting interpretation is equally plausible: the Faroe Island Children study gave internally *inconsistent* results. How is this likely?

First, because there is clear evidence that maternal hair mercury concentration is well correlated with cord blood mercury measurements either from an independent study (e.g., Figure 1 in Ask Bjornberg et al., 2003, *Environmental Health Perspectives*, vol. 111, 637-641) or even from the Faroe Island data base itself (e.g., Budtz-Jorgensen et al., 2004), it is puzzling that *no clear association* can be demonstrated when maternal hair mercury is used as the independent variable.

Second, Professor Gary Myers explained "Hair mercury was used [in Seychelles Child Development Study] because it is the standard measure used in nearly all other mercury related studies of this question. Mercury is thought to enter the hair and brain in a similar fashion. Hair was also chosen because hair has been shown to follow blood concentrations longitudinally, and samples of hair can recapitulate the entire period of exposure, in this case the period of gestation. As part of our research we have shown that

hair levels reflect levels in target tissue, brain [emphasis added]. Measuring mercury in blood requires correction for the red blood cell volume (hematocrit) since the mercury is primarily in red blood cells and reflects only very recent exposure. It can also vary if recent meals with high mercury content are consumed." It has long been known that the methylmercury which crosses the placental barrier has levels in cord blood slightly higher than that in maternal blood (i.e., at a factor of 1 to 2), and that methylmercury levels in fetal brain tissue are about 5 to 7 times higher than in maternal blood (Cernichiari et al., 1995, *Neurotoxicology*, vol. 16, 705-710).

Third, Myers noted that even the 3 statistical associations found by the Faroe Island study may be less impressive than we are lead to think if one compares the Faroe Island statistical outcomes with those from Seychelles Island study. Myers continued, "Through 107 months (9 years) and over 57 primary endpoints, the [Seychelles Island] study has found only three statistical associations with prenatal MeHg exposure. One of these associations was adverse, one was beneficial and one was indeterminate. These results might be expected to occur by chance and *do not support the hypothesis* [emphasis added] that adverse developmental effects result from prenatal MeHg exposure in the range commonly achieved by consuming large amounts of fish. The test results do show associations with factors known to affect child development such as maternal IQ and home environment so there is evidence that the tests are functioning well [i.e., Seychelles Island Child Development Study shows evidence for a high degree of internal consistency]."

Still another serious criticism is that the Faroe Island study, though designed to study the effects of methylmercury, was *contaminated by maternal exposure to high levels of DDT and PCBs* via consumption of pilot-whale blubber (i.e., PCBs about 600 times the so-called Aroclor 1254 Rfd level established by EPA's Integrated Risk Information System, see Dourson et al., 2001, *Neurotoxicology*, vol. 22, 677-689). PCBs are believed to cause serious neurological problems indistinguishable from those associated with high levels of mercury and would distort the detection of such problems arising from the exposure to methylmercury alone.

Finally, it should not go unnoticed that in a letter to the EPA, Drs. Kenneth Poirier and Michael Dourson, former EPA Rfd/Reference Concentration Work Group co-chairs, provided scientific findings to the Technical Information Staff at EPA, advising that: "The Faeroe Islands studies are not the proper choice for the critical study for a methylmercury RfD."

Thus, we conclude, in agreement with Dourson et al. (2001), that "The Faroe Islands data are from exposures to a mixture of chemicals. The Seychelles Island data are from exposures to primarily one chemical, methyl Hg. ... We would ... encourage EPA to use the Seychelles Island data as the basis of its methyl Hg RfD. Although fish from Seychelles are likely to also have additional contaminants, the huge doses of PCBs found in the Faroes will not be one of them. The Faroes in turn would make ideal studies to develop mixture RfDs. Many of our fish are contaminated with both chemicals."

(4) "Already, five million American women of childbearing age have dangerous levels of mercury in their bodies, according to the Centers for Disease Control."

This highly simplified, and often repeated statement is likely drawn from the recent paper by Schober et al. (2003, *Journal of the American Medical Association*, vol. 289, 1667-1674) based on the 1999-2000 National Health and Nutrition Examination Survey (NHANES). If so, this is *another very misleading claim*.

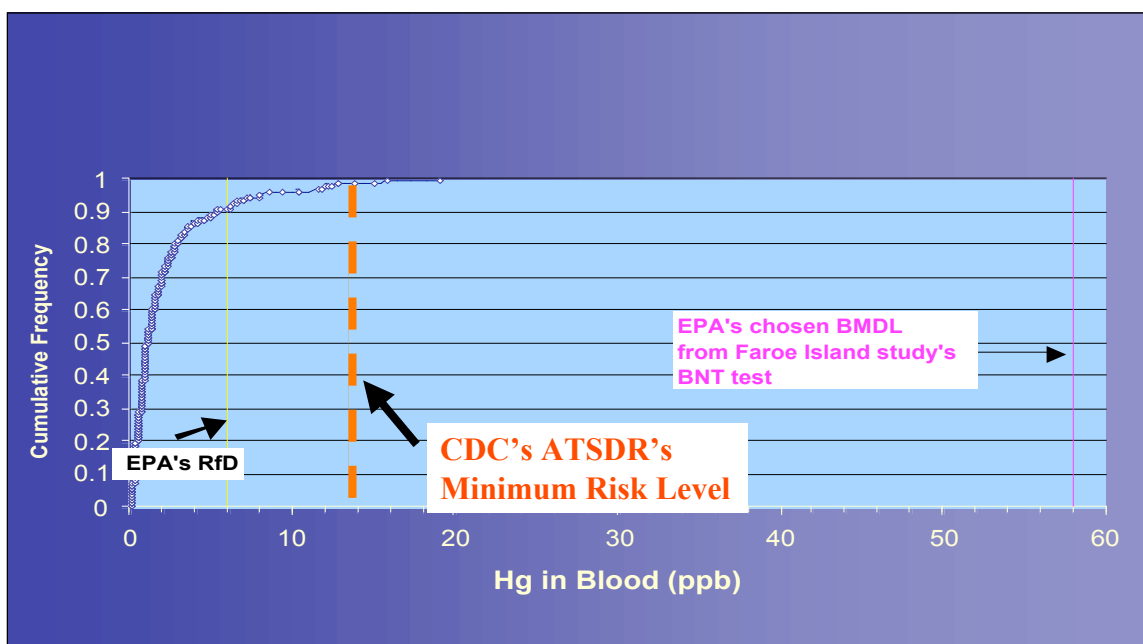
The NHANES result is based on a statistical study of 1709 women aged 16 to 49, and carefully concluded that “8% of women had [methylmercury] concentrations higher than the US Environmental Protection Agency’s recommended reference dose (5.8 $\mu\text{g/L}$), below which exposures are considered to be without adverse effects.” Again, the “8% of women” is reference to the highly limited NHANES statistical sample of 1709 women and cannot be easily extrapolated to the whole US population of about 281 million (2000 census).

More important than the questionable extrapolation is the substance of the results presented in the NHANES paper (**Figure 3**). The fact is that not a single woman in the NHANES study had blood mercury levels exceeding the so-called benchmark dose lower limit value of 58 $\mu\text{g/L}$, or roughly convertible to 58 ppb (parts per billion) as shown in **Figure 3** (see e.g., Mahaffey et al., 2004, *Environmental Health Perspectives*, vol. 112, 562-570) chosen by EPA to represent a risk level *prior* to EPA’s ultimate lowering of the Reference Dose level to a highly conservative 5.8 $\mu\text{g/L}$ (or 5.8 ppb in **Figure 3**). Mahaffey et al. (2004) note another issue in NHANES database:

...the NHANES data on approximately 1700 women contain a few outliers:
... two cases with very large BTHg (total blood mercury) values and low fish/shellfish consumption, as well as the three cases with high fish/shellfish consumption and low total BHg... [Thus,] this review resulted in the elimination of five data points: three had fish/shellfish consumption between 5,303 grams and 7,848 grams and BTHg < 5 $\mu\text{g/L}$ and two had BTHg of 30.3 and 38.9 $\mu\text{g/L}$, but seafood consumption < 500 grams [i.e., 10-15 times less seafood consumption than the former group].

Figure 3

None of the women in the NHANES survey had blood mercury higher than EPA’s chosen Benchmark Dose Lower Limit value, the actual level for triggering a health concern – which is much higher than EPA’s highly conservative RfD level of 5.8 $\mu\text{g/L}$ (ppb).



Adapted from chart shown in the July 2003 EPA/FDA stakeholder meeting

Below are listed four scientific facts that suggest that this popular quote from the NHANES study is more a hyper-conservative precaution than a finding of threatened harm.

Four perspectives on the recent, misunderstood NHANES report that “8% of US women had [blood mercury] concentrations higher than EPA’s recommended reference dose (5.8 µg/L)” (Schober et al. 2003)

(1) The EPA’s Rfd of 5.8 µg/L was based on the Faroe Island’s Boston Naming Test (BNT; **Figure 2**) which has the Benchmark Dose Lower-limit (BMDL) value of 58 µg/L (Rice et al. 2003). If another neuropsychological test, California Verbal Learning Test, is used, the BMDL value can be even higher (103 µg/L). With PCB adjustment, the BMDL value for the BNT test becomes 71 µg/L. This is a *remarkable difference* when calculating levels of exposure and harm.

(2) No woman in NHANES study had a blood mercury level exceeding the BMDL of 58 µg/L chosen by EPA (**Figure 3**). The actual level for triggering a health concern is *much higher* than EPA’s 5.8 µg/L. For example, if the ATSDR’s Minimum Risk Level of 13.6 µg/L (still a conservative number) was used as an alternative specified standard for risk, then **only 1%** of women in the NHANES study would have exceeded this risk level (Schober et al., 2003). For further comparison, the German Human Biomonitoring Commission “determined that adverse effects in children are judged to occur if during pregnancy the mother’s blood contains more than 15 µg/L Hg, roughly equivalent to 4 to 5 ppm Hg in hair.” (Mahaffey et al., 2004)

(3) Compared to the equivalent criteria used by WHO, FDA and CDC’s ATSDR, the *safety factor* of 10 used by EPA to arrive at RfD of 5.8 µg/L may be too conservative: “92 percent of women of child-bearing age already consume below [EPA base] reference dose, while the top 8 percent still have a margin of safety of about *eight-fold*.” (Michael Bolger, Chief of FDA’s Contamination Branch)

(4) The Seychelles Island Child Development Study, with MeHg exposure levels and patterns of consumption more similar to the US population, *does not support* the Faroe Island’s results for adverse effects on child development from maternal fish consumption.

(References: Rice et al., 2003, *Risk Analysis*, vol. 23, 107-115; Schober et al., 2003, *JAMA*, vol. 289, 1667-1674; Mahaffey et al., 2004, *Environmental Health Perspectives*, vol. 112, 562-570)

It is in fact encouraging to find in **Figure 4** that actual field records from Nunavik, Quebec show that the prenatal exposure level of methylmercury, lead and persistent organic pollutants (or POPs) in Inuit infants born between 1994 and 2001 has significantly *declined*. The authors of this new research paper (Dallaire et al., 2003, *Environmental Health Perspectives*, vol. 111, 1660-1664) summarized their study as follow: “Inuit inhabitants of Nunavik (northern Quebec, Canada) consume great quantities of marine food and are therefore exposed to high doses of food chain contaminants. In this study, we report the time trends of persistent organic pollutants [POPs], mercury, and

lead in umbilical cord blood of infants from three communities of the east coast of Hudson Bay in Nunavik. We analyzed 251 cord blood samples collected from 1994 through 2001 for polychlorinated biphenyls (PCBs), dichlorodiphenyl trichloroethane (DDT), dichlorodiphenyl dichloroethylene (DDE), hexachlorobenzene (HCB), chlordanes, lead and mercury. Using an exponential model, we found strongly significant decreasing trend for PCBs (7.9% per year, $p < 0.001$), DDE (9.1% per year, $p < 0.001$), DDT (8.2% per year, $p < 0.001$), and HCB (6.6% per year, $p < 0.01$) [Figure 4]. No significant trends were detected for chlordanes. A significant reduction of lead and mercury concentrations was found [i.e., by more than 8% decrease per year], but there was no clear linear or exponential trend. The decreases observed could be explained by a decrease in food contamination, by changes in dietary habits, or, most likely, by a combination of both. ... In our study population, we believe that POP decline is caused mainly by a diminution of food contamination and, to a lesser extent, dietary changes [emphasis added].”

How about methylmercury? Is there an actual health concern for mercury exposure in this group of Inuit population from Nunavik?

Figure 4

Concentrations of mercury, lead and persistent organic pollutants in umbilical cord blood of Inuit infants born in Nunavik, Quebec have been decreasing from 1994 to 2001

“A significant reduction of lead and mercury concentrations was found, but there was no clear linear or exponential trend. The decreases observed could be explained by a decrease in food contamination, by changes in dietary habits, or, most likely by a combination of both. Although questions remains as to the exact causes of decline, it is encouraging to observe such an improvement in prenatal exposure for this highly exposed population.” **POPs**

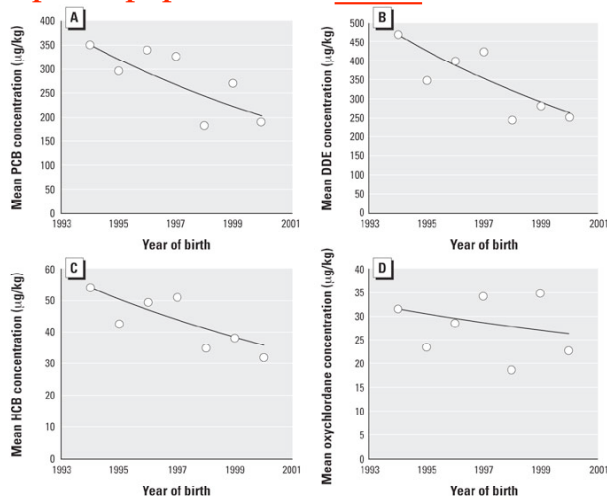


Figure 2. Adjusted mean OC concentrations according to the year of birth: (A) PCBs; (B) DDE; (C) HCB; (D) oxychlordanes. The lines represent the slope estimates presented in Table 2.

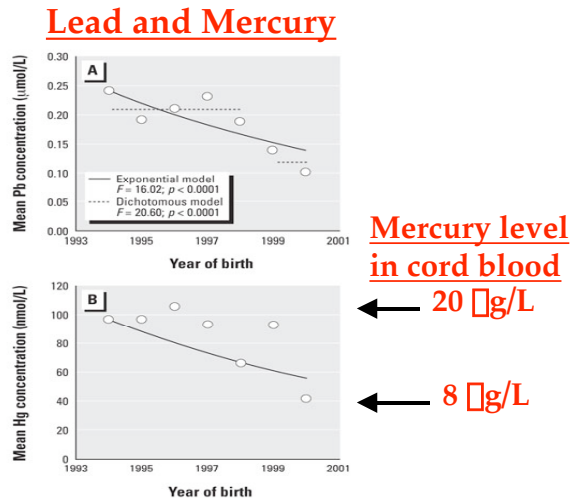


Figure 3. Adjusted mean heavy metal concentrations according to the year of birth for (A) lead and (B) mercury. The solid lines represent the slope estimates presented in Table 2. The dotted lines represent the adjusted mean lead concentrations before and after January 1999.

Dallaire et al, 2003, Environmental Health Perspectives, vol. 111, 1660-1664

Here is the explanation (and caution) from the research team from the Laval University Medical Center in an earlier publication (Dewailly et al., 2001, *Archives of Environmental Health*, vol. 56, 350-357): “According to recommendations formulated by the World Health Organization (WHO), no more than 5% of individuals in a population should display a methylmercury concentration that exceeds 1,000 nmol/L [or converted to 200 $\mu\text{g}/\text{L}$]. Concentrations of total mercury noted in present study did not exceed 560 nmol/L [112 $\mu\text{g}/\text{L}$]. ... WHO issued

more stringent recommendations for pregnant women, stating that not more than 5% of this subgroup should exhibit methylmercury concentration above 400 nmol/L [80 µg/L]. In our survey, no women of child-bearing age exhibited concentrations of this magnitude (maximum concentration in the 18-44 age group: 397 nmol/L [79.4 µg/L]). ... Recent data from Faroe Islands suggest that the neurologic status of children can be affected by low-level prenatal exposure to mercury. ... There are, however, major differences between the diet of Faroese and the diet of Inuits, and care must be exerted before one concludes that Inuit children are at risk. ... [I]n view of the high selenium intake [in the diets of the Inuit population from consumption of mattak (beluga whale skin) which is about 2.4 times higher than that measured in the Farose], which may counteract methylmercury-induced toxicity, *local public health authorities did not recommend reducing seafood consumption [emphasis added].*"

Sierra Club: *So it made sense that on December 10, 2003 the Bush Administration would warn Americans to limit the amount of fish we eat and feed our kids.*

What didn't make sense is that five days later the administration announced plans to give power plant permission to shower more toxic mercury into our lakes and streams — where it accumulates in the bodies of fish. And even though the EPA estimates 90 percent of the mercury in our air can be eliminated by 2008 by enforcing the current Clean Air Act and using existing technology, the Bush Administration wants to extend the deadline until 2018.

CSPP's Comments:

(5) *"...to shower more toxic mercury into our lakes and streams..."*

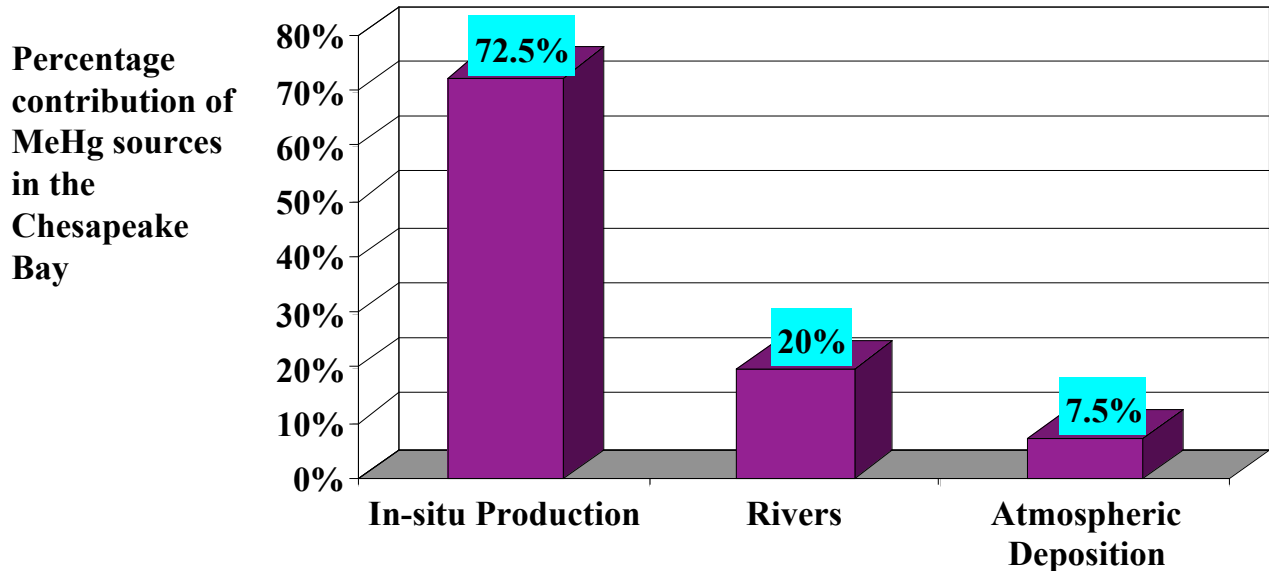
It seems rarely understood by non-scientists that the kind of mercury emitted into the atmosphere from power plants (US or otherwise) and eventually re-deposited back into the oceanic and terrestrial ecosystems is mostly in the elemental form (Hg₀) and the dissolved inorganic form (Hg²⁺), not methylmercury (MeHg) — the biologically active form believed to affect health. There is a long-chain of physical, chemical and biological processes (referred to as the biomethylation and bioaccumulation) that convert various forms of mercury into methylmercury. *Understanding any discussion of mercury's health effects requires some careful analysis, ignored by the Sierra Club.*

For a more in-depth understanding, it must be emphasized that the biomethylation and bioaccumulation processes in the ecosystems and food web responsible for converting inorganic Hg into MeHg (which appears in fish) are not directly related to, nor limited by, the amount of inorganic mercury (as emitted from U.S. power plants) available. In practice, the amount of methylmercury is limited by ecosystem dynamics, water quality variables like dissolved sulfate, parameters like the population of algae and/or zooplankton,¹ the availability of nutrients and/or sunlight and so on.

The supply of inorganic (elemental) mercury *does not* necessarily lead to more or less methylmercury produced.

Figure 5

Sources of methylmercury in the Chesapeake Bay: Atmospheric deposition is a not an important contributor



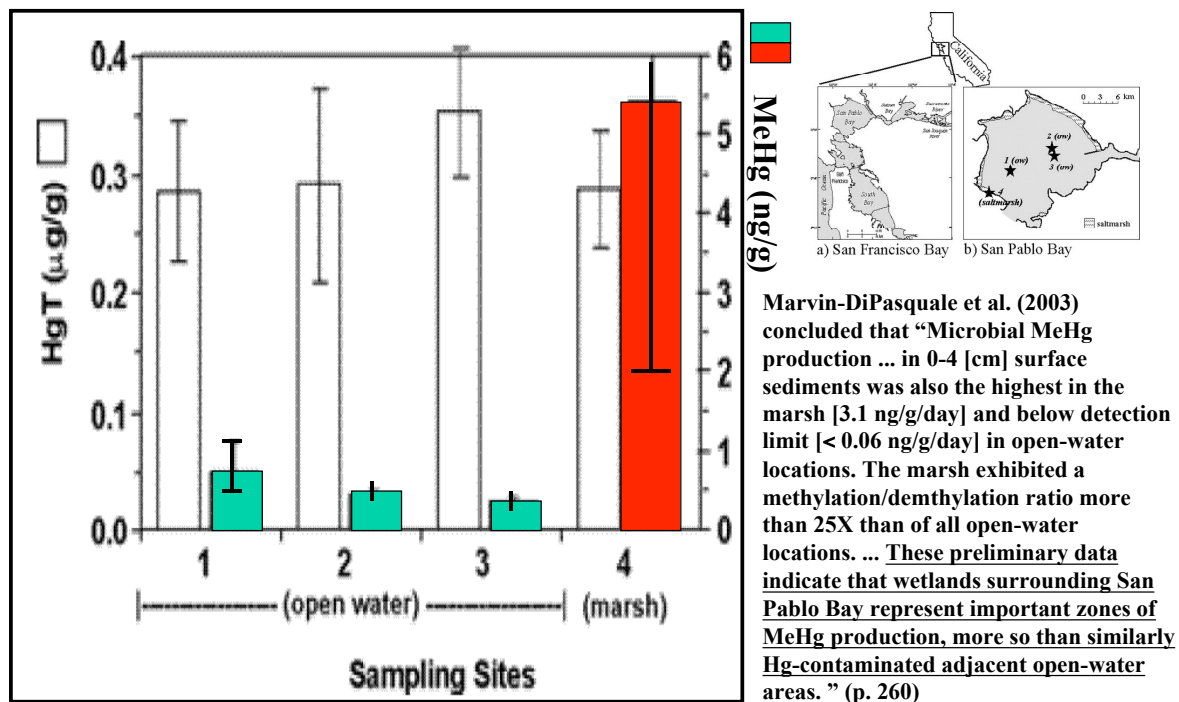
Reference: Mason et al. (1999)

Equally important are the sources of methylmercury. For example, Mason et al. (1999, *Marine Chemistry*, vol. 65, 77-96) found that, through budgeting of the biogeochemical cycling and tracking of various species of mercury in the Chesapeake Bay (**Figure 5**), most (72.5%) of the methylmercury in the system comes from *in-situ* production annually. Remote transport from rivers contributes about another 20%, and the atmospheric deposition only about 7.5%. Thus, *factors other than power plant emissions* dominate the production of methylmercury in the Bay's ecosystems.

As another example, a recent study of microbial cycling of mercury in sediments of San Pablo Bay, California, Marvin-DiPasquale et al. (2003, *Environmental Geology*, vol. 43, 260-267) noted that "sediment geochemistry (redox, sulfide, pH, organic content, etc.) is a much more important control on MeHg production than is the absolute Hg [total Hg] concentration."²

Figure 6

Mircobial methylmercury (MeHg) production in marsh wetlands are 25-50 times more than in open-water locations around San Pablo Bay area



Reference: Marvin-DiPasquale et al. (2003) *Environmental Geology*, vol. 43, 260-267

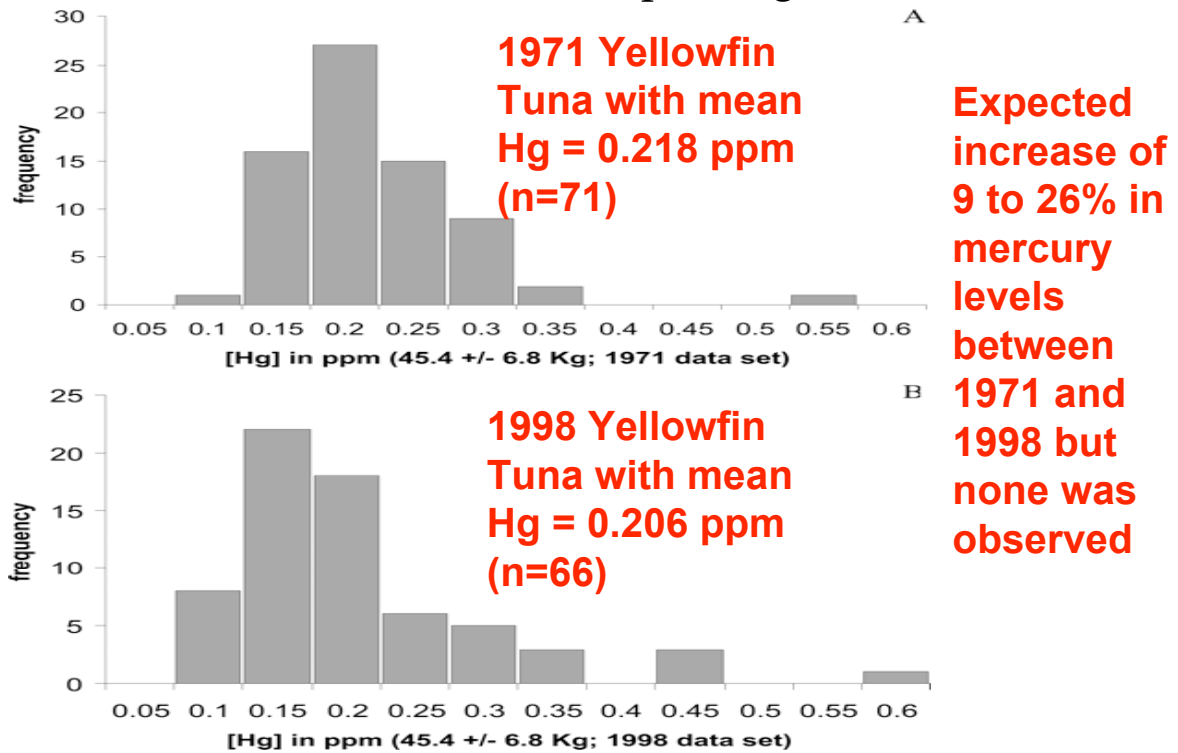
It was found that despite the relatively constant level of total inorganic mercury available in all four sampling sites (the four un-colored bars in **Figure 6**) in that study of 3 open-water and 1 salt-marshland sites, the production and concentrations of methylmercury are significantly enhanced at the biologically active and organically rich marsh wetland site (red bar versus the three green bars).³ **Figure 6** again emphasizes the important fact that production of methylmercury in the natural ecosystems is dominated by factors *other* than the available amount of inorganic mercury, such as that from power plants or other industrial emissions. *Mercury is naturally ubiquitous in our environment, the oceans alone containing tens of millions of tons (with deep ocean floor volcanic vents being likely natural regions for production of methylmercury in the world’s oceans; see Kraepiel et al., 2003, Environmental Science & Technology, vol. 37, 5551-5558). Nothing humans do is ever likely to completely remove it.*

(6) “...where it accumulates in the bodies of fish”

Consequently, it is not surprising (**Figure 7**) that a recent effort by scientists from Princeton University and University of Louis Pasteur (Kraepiel et al., 2003, *Environmental Science & Technology*, vol. 37, 5551-5558) has failed to find the expected *increase* in the level of mercury in yellowfin tuna caught in 1998 when compared to similar cohorts caught in 1971. These latest negative results for detection of the suspected effects of man-made mercury emissions only emphasizes the need for a more in-depth, scientific understanding of the natural cycling of mercury, without the constant distraction of alarmist calls for premature policy activism.

Figure 7

No increase in mercury levels for Yellowfin tuna caught in 1998 relative to a similar sample caught in 1971



Kraepiel et al., 2003, *Environmental Science & Technology*, vol. 37, 5551-5558

The science is becoming increasingly clear that even the complete elimination of mercury emissions from US power plants (see CSPP's comment # 7) would not materially change the levels found in either the fish or those who consume them; no significant effect, detectable or otherwise, on maternal or fetal health would result from even stringent control measures.

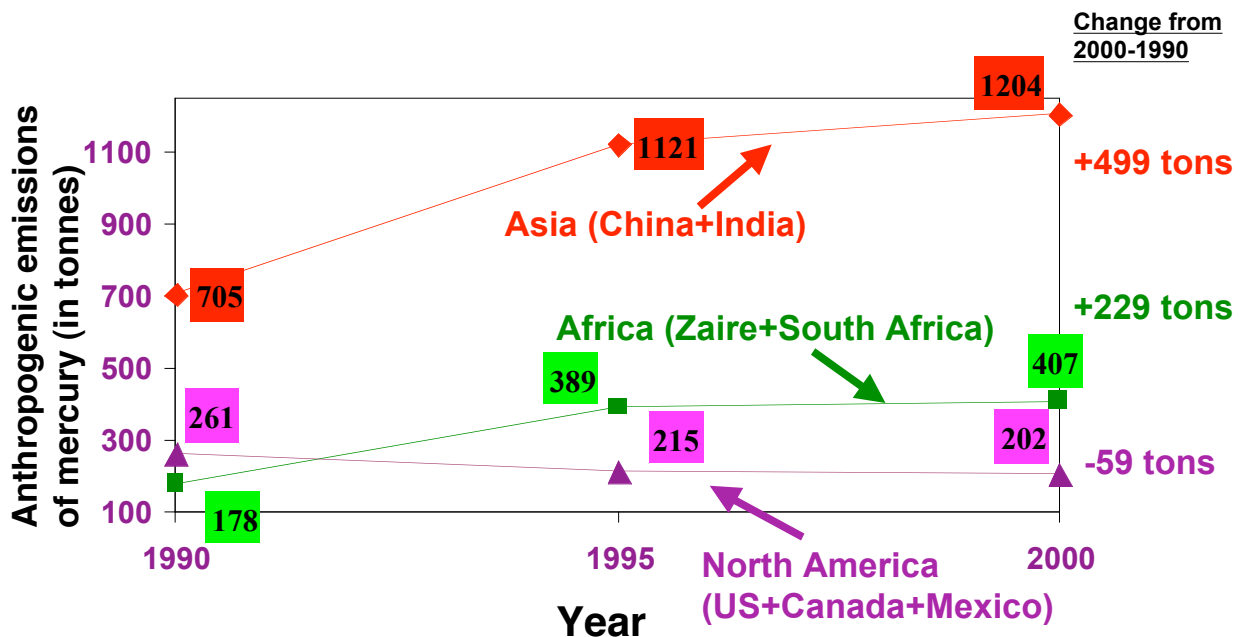
(7) *"...even though the EPA estimates 90 percent of the mercury in our air can be eliminated by 2008 by enforcing the current Clean Air Act and using existing technology,"*

This is *serious misinformation* on the part of Sierra Club, and a rather simplistic view considering that no cost-benefit issue is even raised with such a serious call for eliminating of 90% of mercury emitted by US power plants.

First, it must be noted that with regards to eliminating mercury emissions, the United States (and North America) has made much progress (**Figure 8**). The Department of Energy (DOE) has noted that "In 1993, U.S. yearly [mercury] emission totaled 242 tons [and by] the end of the decade, emissions had declined to less than 160 tons per year." That significant one-third reduction was achieved mainly through control of mercury emissions from municipal and hazardous waste combustors, batteries, paints, and medical waste incinerators. The result is that today the United States accounts for only about 3% or less of the world's annual inventory of mercury emissions (**Figure 1**).

Figure 8

US mercury emission is small and has been decreasing over time. (There is likely a management floor to the already-low US mercury emission sources relative to the rest of the world.)



Adapted from presentation by Jozef Pacyna of the Norwegian Institute of Air Research (private communication March 4, 2004)

Second, it is questionable that current technology allows a uniform 90% reduction — at least as far as coal-fired power plants are concerned. The DOE admitted as much when it reported that a mercury “pollution control system can be effective in removing as high as 90% of the incoming coal’s mercury levels in a few cases while in others, very little mercury is removed.”⁴

An October 2001 DOE Energy Information Agency report (available from <http://www.eia.doe.gov/environment.html>), commissioned by Senators Jeffords and Lieberman, warned against rushing ahead with strict curbs proposed by the two senators: “Meeting the individual limits for NOX, SO₂, Hg [mercury], and CO₂ will all require significant effort; the CO₂ and Hg limits [the proposed 90% reductions conforming to Sierra Club demands] are likely the most difficult to meet. ... [M]eeting the assumed Hg limit of 4.3 tons probably would require some fuel switching. This limit for Hg implies removing 95% of the Hg in coal used by electricity generators today. For many combinations of plant and coal type, existing technology may not be able to achieve this level of removal.” The report continued: “Hg emissions control technologies are relatively new and untested on a commercial scale. As a result, their cost and performance are highly uncertain. The more rapid technology development assumed in the advanced technology case and in the CEF [Clean Energy Future] case [requested by Senators Jeffords and Lieberman] is more uncertain and represents a *higher level of risk* for the ultimate success and timing of the technology improvement.”

Finally, despite the obvious difficulties in providing any accurate estimates, DOE suggested that the cumulative costs of generating electricity in the United States under such a severe emission controls regime (such as proposed by Senators Jeffords and

Lieberman) would swell by 8 to 9%, or between \$142 and \$177 billion. Worse still, it is clear from CSPP's comments # 5 and # 6 that *even if these draconian cuts were achieved at great cost, the sought after health improvements would be undetectable.*

Conclusion

Sierra Club: *So why would the Bush Administration — knowing how dangerous mercury is — keep our families and communities at risk an additional decade? Maybe millions from the polluting companies that contributed to the 2000 Bush/Cheney campaign had something to do with it?*

CSPP Comments: The mercury alarmists in some government agencies and their drivers among special interest environmental groups such as the Sierra Club and Friends of the Earth have not proven that Americans face any real health threat from current fish consumption, while *their own misinformation* may harm public health.

Their sensationalized claims in the media are based on little more than questionable research, often non-transparent data sets and highly subjective and sensational interpretations.

On balance, the existing evidence suggests that methylmercury exposure from fish consumption during pregnancy, of the level seen in most parts of the world, does not have measurable cognitive or behavioral effects in later childhood. ... For now, there is no reason for pregnant women to reduce fish consumption below current levels, which are probably safe.⁵

Also, actual clinical experience *could not find association of high blood mercury with health complaints*, according to doctors from Harvard Medical School (Kales and Goldman, 2002, *Journal of Occupational and Environmental Medicine*, vol. 44, 143-154).

In a sharp contrast, the *misinformation and alarmism spread by NGOs like the Sierra Club, Friends of the Earth and others have great potential to harm public health* if reductions in fish consumption continue to occur, especially among pregnant women and children. If these organizations were truly concerned with the health and welfare of women and children, they should apply their *precautionary approach about the potential indication of harm, not the actual proof of it*, to their own public mis-statements that American women and children are “being poisoned by deadly mercury from power plants” (Friends of the Earth, March 16, 2004's advertisement in USA TODAY), and therefore should limit “the amount of fish we eat and feed our children” (Sierra Club, January 20, 2004's advertisement in Washington Post). The literature is vast with potential mitigations of serious negative health conditions attributed to intake of *omega-3 polyunsaturated fatty acid* gained via fish consumption, a sample being:

- (a) cardiovascular disease + coronary heart disease (CHD) [He et al., 2002, Kris-Etherton et al., 2002, Hu et al., 2002, Iso et al., 2001, Daviglius et al., 1997] + sudden deaths [Albert et al. 2002, Marchiolo et al. 2002]
- (b) breast cancer [Gago-Dominguez et al. 2003, Terry et al., 2003, Maillard et al., 2002, Pala et al. 2001]
- (c) prostate cancer [Terry et al., 2001; Norrish et al., 1999]
- (d) endometrial (inner lining of uterus) cancer [Terry et al. 2002]

- (e) Alzheimer disease [Morris et al., 2003]
- (f) type 2 diabetes in women [Salmeron et al., 2001] and CHD in type 2 diabetic women [Hu et al., 2003]
- (g) pre-term delivery and low birth weights [Smuts et al., 2003; Olsen and Secher, 2002] + physiological and mental development of infants [Bouwstra et al., 2003, Clarkson and Strain 2003, Helland et al., 2003]

Another pertinent warning was given by Charles Lockwood (now as chairman of the Obstetrics and Gynecology department at the Yale University School of Medicine):

“Almost every obstetrician I talk to knows about the FDA mercury recommendations.... It is tough enough because we terrify pregnant women with every conceivable turn of the page. They are worried about having babies with Down Syndrome or chromosomal abnormalities; they go through all these screening tests, which result in patients being scared out of their wits for no reason, and here’s yet another thing coming down the road: you can’t eat fish anymore.”
(<http://www.tunafacts.com/press/2002/mar14.cfm>)

“[W]e are concerned that, in fact, *we don’t know enough about the neurodevelopmental effect of mercury. The literature has been, at best, unconvincing.* [Emphasis added] ... Reviewing the data from Faroe Islands and the Seychelles Islands, as well as the New Zealand study leaves us a little but more lost. It is unclear whether or not you can set a specific exposure level that would be safe and, conversely, one that would represent the lower limit of absolute risk. ... We would like to urge the NIH and other federal agencies to support research to establish in a much more rigorous way what mercury does to the developing infant’s brain. ... I suppose that at this point, if we are left with increasingly concerning information about the lack of a lower limit of mercury exposure, pregnant women will stop eating fish, but there are a lot of health benefits of eating fish and it is a relatively cheap source of protein. There may be some additional benefits of reducing oxidative stress that might induce preeclampsia or pre-term delivery; may affect fetal growth restriction by impairing placentation. So, there are a lot of reasons to think that fish might be useful for pregnant women to take in ...”
(<http://www.fda.gov/OHRMS/DOCKETS/ac/02/transcripts/3872t2.htm>)

Nor have these NGOs proposed realistic and safe solutions to the problems they suppose exist. To the contrary, their now routine prescribed medicine – extreme reference dose levels, ill-conceived fish advisories and attenuation of safe and reliable energy sources – appears far more dangerous than the supposed illness, creating a predictably large negative impact on public health by unnecessarily placing adults and children alike at greater risk for suffering and pre-mature death via degraded nutrition, more expensive energy (**Figure 9**) and emotional stress.⁶

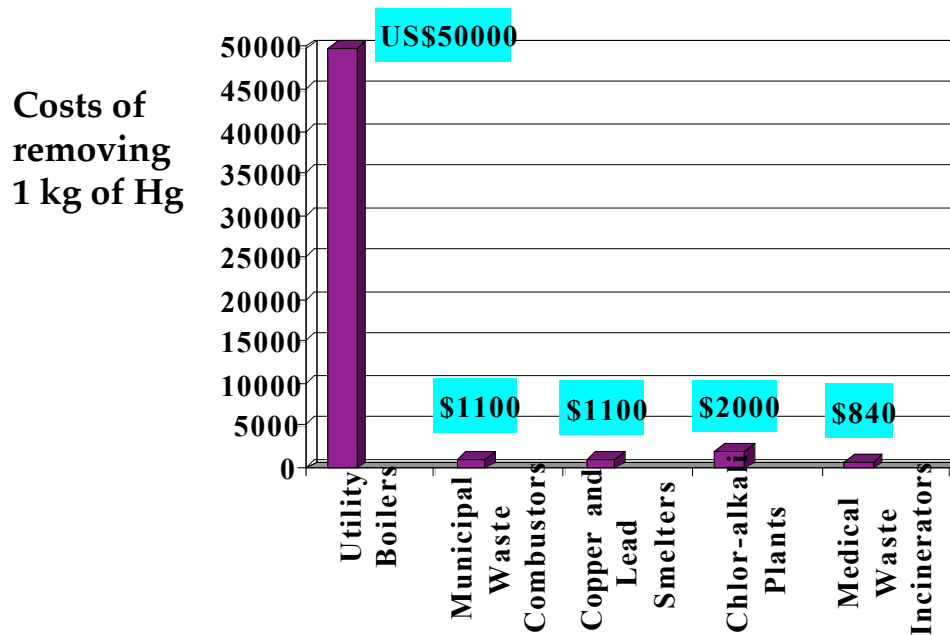
Again, because mercury is found in nearly all forms of fossil fuels (accounting for about 85% of US energy needs), alarmism-driven regulations could drive US energy costs so high as to fatally endanger not only public health, but also our national economy and the family incomes of both current workers and retirees. Especially the lives and livelihoods of minorities, the poor and the elderly could be decimated.

Therefore, we are left to conclude that the scientifically baseless accusations in paid advertisements and public policy initiatives by organizations such as the Sierra Club and

Friends of the Earth (USA TODAY, March 16, 2004) are likely politically and financially (fund-raising) motivated.

Figure 9

Cost estimates of removing 1 kg of Hg is disproportionately expensive for electric utility boilers



Adapted from presentation by Jozef Pacyna of the Norwegian Institute for Air Research (private communication March 4, 2004)

Attachment:

Comments on the Proposed Utility Mercury Reductions and Interstate Air Quality Rules

Testimony in Chicago, Illinois on February 25, 2004

By Lee H. Walker

Director and Senior Fellow of The Heartland Institute
and Director of the New Coalition for Economic and Social Change

Thank you for giving me this opportunity to testify on the proposed utility mercury reductions and interstate air quality Rules. I am not a scientist. I am, however, somewhat expert in how public policy is made and the unintended impacts it can have on minority and low-income people. I believe this is one such case.

The Bush Administration is proposing dramatic reductions in sulfur dioxide, nitrogen oxides, and mercury from power plants, more in fact than health and environmental experts at the Mercatus Center, the Cato Institute, the American Enterprise Institute, and other respected think tanks say is justified in terms of the health risks and costs involved. By trying to reduce emissions too much, too fast, we risk incurring social costs that far outweigh whatever small and hypothetical health benefits we might be aiming for.

The Administration is softening the blow by offering to allow emission trading, similar to what was done, successfully, to reduce sulfur emissions at a reasonable price. Emission trading means companies with high costs of reducing emissions can buy emission permits from those with low reduction costs, meaning the required reduction takes place at the lowest cost. It's a good policy, although in this case it is being used to reduce costs that are unnecessary in the first place.

Professional environmental advocates say the reductions are not enough, and they think emissions trading allows some polluters to continue to pollute, harming their neighbors. (Note that I say "professional environmental advocates," because the overwhelming majority of environmentalists know little about this issue and are not participating in the debate. The newsletters and fundraising letters they receive from the professional environmental advocates thoroughly misrepresent the issue.)

I have no sympathy for their claims. I believe they are wrong.

According to the Environmental Protection Agency, mercury emissions and their presence in the air are strongly trending downward (as are all other pollutants), and are expected to keep falling due to technological change and implementation of current standards, even without new legislation. Most of the mercury in the air and entering the Great Lakes today comes either from natural sources or from China and other third world countries that burn coal without any emissions control. More strict standards on power plants here in the U.S. obvious will have no effect on those sources, and consequently have no effect on air or water quality.

There is little hard evidence that eating fish and breathing current ambient levels of mercury pose a health threat, even to children and pregnant women. I know this is a controversial assertion, and I have already admitted that I am not a scientist. So for documentation of my claims, I urge you to go to The Heartland Institute's Web site at www.heartland.org and use its "PolicyBot" search engine to search for "mercury." You will find nearly a dozen studies and commentaries exposing the junk science behind the environmental movement's effort to link fossil fuel combustion with mercury emissions and health effects.

So why, really, are environmentalists calling for steep reductions in mercury and other power plant emissions? By demanding unreasonable reductions in mercury, they hope to discourage the use of coal and eventually other fossil fuels (oil and natural gas), which they think will lead either to a Garden of Eden style lower-output economy where most of us are poor but enjoy ourselves, or some science-fiction style advanced-technology economy where windmills, solar panels, and fuel cells generate all the power we need without a smokestack in sight.

Let's get real. Neither scenario is likely to pan out.

What is most likely to happen – indeed, what environmentalists expect will happen – is that energy prices will rise, economic growth will slow, and unemployment will rise. It is undeniable that when this occurs, black and low-income people will be harmed the most.

Energy costs take a bigger bite out of the budgets of low-income folks than of higher-income folks, so higher energy costs are regressive. Higher energy costs also mean slower economic growth – the American Council for Capital Formation has demonstrated this fact to virtually no rebuttals – and African Americans and the poor are still the "last hired and first fired." So we get hurt a second time.

And manufacturing is particularly affected by higher energy costs, because manufacturing requires more energy than the service and high-tech sectors of the economy, and higher energy prices therefore make it more difficult for manufacturers in the U.S. to compete with manufacturers located in other countries.

I have to wonder how many of the people in this room, testifying for more strict environmental standards than what the Bush Administration has proposed, work in factories. Not many, I'm sure.

I see wealthy and white environmentalists advocating a feel-good policy without regard to the impact it would have on people of color, lower-income people, and blue-collar workers. The tears they cry for "poor people" exposed to pollutants are insincere. They are indifferent in this case to the suffering their policies impose on the poor and the black community, just as they are indifferent to the suffering caused by their constant advocacy of higher taxes and more regulation of industry.

They are misusing science and ignoring economics. Consequently, I urge you to reject their call for even more draconian reductions in emissions than the President has proposed.

#

Lee H. Walker is a Director and Senior Fellow of The Heartland Institute and Director of the New Coalition for Economic and Social Change. He is a former member of the Board of Directors of the Chicago State University Foundation, a Commissioner with the Midwestern (10 States) Higher Education Commission; a trustee of the Illinois State Community College Board System; a member of the Community Advisory Panel of WTTW TV (PBS); and a member of the Board of the American Fund for the University of the Orange Free State (South Africa).

¹ P. Pickhardt et al. (2002) *Proceedings of the National Academy of Sciences*, vol. 99, 4419-4423.

² From p. 266 of M. C. Marvin-DiPasquale et al. (2003) *Environmental Geology*, vol. 43, 260-267.

³ Marvin DiPasquale et al. (2003) said: "marsh sediments located around the periphery of the bay appear to be the most active zone for net MeHg production, presumably because of both the organic-rich nature of these zones, and the ability of rooted macrophytes [bottom water's large plant life] to supply molecular oxygen at depth in the sediment, thus keeping reduced-S levels low." They continued, "This has important implications for the wetland reconstruction proposed for this area. Without sufficient safeguards, substantial wetland reclamation efforts may result in an overall increase in MeHg production in these newly constructed wetlands, with net MeHg export to the larger bay." In other words, reclamations of wetland may have to contend with potential complications of enhanced MeHg production and the ultimate transport elsewhere.

⁴ In a September 2001 DOE's Energy Information Agency report (available from <http://www.eia.doe.gov/environment.html>), requested by Senators Smith, Voinovich, and Brownback, it was noted that "Considerable uncertainty exists about the ability of various types of emissions control equipment to remove Hg ... The removal rates for various coal plant configurations ... showed significant variation. The 1999 data show that, on average, a cold-side electrostatic precipitator (CSE) — a particulate removal device — removes 31 percent of the Hg that passes through it. However, the variation among plants with CSEs was large, ranging between 0 percent and 87 percent removal. The situation was similar for facilities with fabric filters — another type of particulate removal device. "

⁵ C.G. Lyketsos, 2003, *The Lancet*, vol. 361, 1667-1668

⁶ See *Mortality Reductions from Use of Low-cost Coal-fueled Power: Analytical Framework*, Klein and Keeney, Dec. 2002