



American Fisheries Society
US Environmental Protection Agency

National Forum on Contaminants in Fish

October 20-22, 2002

Burlington Vermont

Proceedings



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The following Steering Committee members and other individuals contributed their time and expertise to develop the agenda for the 2002 Forum program, identify and recruit speakers, determine priorities, and facilitate discussions:

Jeffrey Bigler, EPA, Office of Water, Co-Chair

Betsy Fritz, AFS, Co-Chair

Robert Brodberg, California Environmental Protection Agency

Eric Frohmberg, Maine Bureau of Health

Razelle Hoffman-Contois, Vermont Department of Health

Barbara Knuth, Past President, AFS Water Quality Section, Cornell University

Janet E. Lubeck, American Fisheries Society

Randall Manning, Georgia Department of Natural Resources

Patricia McCann, Minnesota Department of Health

John Persell, Minnesota Chippewa Tribe

Andy E. Smith, Maine Bureau of Health

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Introduction

Representatives of 47 states, 30 tribes, 6 federal agencies, several Canadian provinces and other interested organizations attended the 2002 Forum on Contaminants in Fish sponsored by the US Environmental Protection Agency and convened by the American Fisheries Society in Burlington Vermont.

The agenda was developed by a steering committee with representatives of states, tribes, federal agencies and the AFS. The steering committee developed an agenda that presents a variety of perspectives and approaches to the difficult issues facing states and tribes, including how to address cumulative risks and mixtures; risks to those most exposed; and the need to integrate perspectives and responsibilities of health and environment agencies. The Forum also included topical breakout sessions for more in-depth presentations and discussion on Sunday, along with the regional breakouts that have been customary. The forum also included a poster and information exchange session.

This document presents the proceedings of the Forum. It includes summaries of all presentations in the plenary session, copies of slides presented, a list of participants, and other information about the forum. Additional copies are available from the American Fisheries Society in Bethesda, Maryland.

Summary of Conference Presentations

At the 2002 forum, 33 speakers presented technical information, perspectives on policy development, and experiences in developing and implementing advisory programs. Biosketches for the speakers are included in the appendix, as are black and white copies of slides presented.

The presentations were organized into nine sessions:

- Welcome and Introductions
- Guest Speaker
- Update on Activities Related to the 2001 Forum
- Reports from the Weekend Sessions
- Advisories for Commercial Fish: Federal, State, and Tribal Approaches
- Hot Topics – Chemicals of Concern
- Approaches to State and Tribal Advisories
- Approaches to Considering Benefits in Advisory Programs
- Current Science on the Benefits of Fish Consumption

Moderators for the panels offered additional comments and perspectives. In addition, forum participants had an opportunity to ask questions and make comments after most of the presentations.

Seven additional presentations were made during workshops held on Sunday October 20. While these presentations are not summarized in this document, slides from these talks are included in the Appendix.

This section provides short summaries of the presentations.

I. Welcome and Introductions

Jeffrey Bigler, US Environmental Protection Agency

Good morning, and welcome to the 2002 National Forum on Contaminants in Fish, sponsored by the American Fisheries Society, US EPA, and the Vermont Department of Health. My name is Jeff Bigler and I will serve as the overall moderator for this year's Forum.

This year, we have a full house - and then some. More than 240 have registered, making this a banner year for the Forum. We had originally planned on accommodating up to 120 registrants and we obtained rooms based on this estimate. Therefore, two weeks ago AFS found it necessary to close registration as the participation list approach 250. Fortunately, in the end, AFS was able to accommodate all who registered for the Forum - but don't be surprised if you wind up sharing a donut during the breaks.

Attending the Forum this year are representatives from 47 states, 30 tribes, 6 federal agencies, several Canadian Provinces, and scores of others from various agencies and organizations. We have some of the nation's experts on the occurrence of chemical pollutants in fish and the potential health risks and benefits associated with fish consumption. Many experts are on the agenda, while others are here to join in discussion over the next two days. I urge you all to take advantage of the opportunity provided by the Forum to share your experiences and thoughts, successes and failures. Whether you interact in the Plenary, in the halls during breaks, or perhaps after hours at a local watering hole, please use this opportunity to meet others and share your work with them. After all, we all share a common goal; that is the goal of ensuring that decisions regarding the issuance of fish consumption advisories are based on sound science and sound public health policy.

Let's now move on to the agenda. As in the past, the agenda for the Forum was developed by a joint state/tribal/AFS/EPA steering committee. This year's steering committee members include:

Betsy Fritz, American Fisheries Society, Co-Chair
Jan Lubeck, American Fisheries Society
Robert Brodberg, California Environmental Protection Agency
Razelle Hoffman-Contois, Vermont Department of Health
Barbara Knuth, Cornell University; Past President, AFS Water Quality Section
Randall Manning, Georgia Department of Natural Resources
Pat McCann, Minnesota Department of Health
John Persell, Minnesota Chippewa Tribe
Andrew E. Smith/Eric Frohberg, Maine Bureau of Health
Amy D. Kyle, University of California Berkeley and Consultant to AFS

The Forum has always been driven by the participants – states and increasingly tribes. The steering committee decided to take on some challenging issues at the Forum, such as how to assess cumulative risks and mixtures; issues for those at the upper end of the distribution for exposure; ways of thinking about risks and benefits for people who are traditional users of fish. These are tough and important issues. The agenda also reflects the need to integrate both “health” and “environmental” agency perspectives and responsibilities: both play an important role.

On behalf of the entire Forum, I would like to thank the committee members for participating in six months of conference calls, reviews and endless phone calls to potential speakers in order to ensure that this year's Forum provides a balanced, stimulating, and thought-provoking agenda. I have no doubt that, at the end of the day, you will agree that the steering committee succeeded in developing such an agenda. Please join me now in thanking the steering committee for all of their hard work.

Gus Rassam, Executive Director, American Fisheries Society

Welcome. Since the first forum in this series in 1990, the American Fisheries Society has been pleased to co-sponsor this important venue for exchanging information on an extremely important topic, with the Environmental Protection Agency. Aside from one previous forum held in Chicago, AFS and EPA have been partners in bringing the best each organization has to offer to the benefit of all the community. AFS brings its long track record in arranging and holding scientific meetings, and EPA provides the capability to bring together various state programs, federal agencies, tribal programs, and other stakeholders, all working toward common goals of helping protect the public from effects of contaminants contained in fish.

Since 1990, much progress has been achieved. Fish consumption advisories are now common in most of the states, and these advisories are underlain by the best scientific data available. Aside from such an increase in awareness, the major discernible changes that came from previous fora can be summarized as follows:

- There is an increasing awareness of the need for community involvement in both setting standards and communicating advisories to target groups.
- Increased collaboration among neighboring states to achieve consistency of approach.
- Public awareness of the health problems associated with mercury levels in waters, especially in most of the eastern, Midwestern, and southern United States.
- Assessment of “emerging” contaminants such as flame retardants or pharmaceuticals.
- Creation of Web-based communication tools such as the National Listing of Advisories.

The total knowledge-base on contaminants, their levels in both water and the fish swimming in it, and their effects on health of target demographics, has expanded tremendously during that time period, thanks mainly to the diligent efforts by scientists working in EPA and university laboratories.

On the other hand, all this knowledge still needs to reach people—and reach them in the right way and at the right time. Integrating the information in the popular culture and making sure that people understand it and act on it is still a major challenge. This is especially true since no one wants to turn people away from a healthy, fish-based diet.

This forum will allow the spirit of cooperation among State, Federal, and Tribal agencies to expand. It will increase our common understanding of the scientific database of contaminants and will certainly lead to better ways of communicating that scientific information to the public.

Thank you for contributing to these goals.

G. Tracy Mehan III, Assistant Administrator for Water, US EPA

Congratulations are due to AFS on the program for the forum and partnerships they have fostered through their sponsorship and organization of the forum.

My experience, including working in the Great Lakes, has given me a first hand awareness of persistent, bioaccumulative, toxic pollutants, which are very important. The problems of such contaminants in fish raise serious risk management and risk communication issues. What we see in terms of contaminants in fish is an indicator of success in other programs that control releases of pollutants to the environment and clean up past releases.

I want to emphasize how important it is that you continue your great work to identify risks from contaminants in fish and communicate them to people at risk, especially women and children. I urge you to keep the issue in the forefront. I also recognize that we need to address current air pollution issues as well as continuing, or “legacy,” contamination releases from sites of past disposal.

It is important for all of us to note the successes that we have achieved. One important success for EPA relates to mercury, which is widespread in fish but primarily comes from air deposition. EPA is closing in on 50% reduction in mercury releases to air due to development and implementation of technology-based standards limiting mercury releases in industry sectors (known as “MACT” standards.) We also hope to achieve international efforts in cooperation with the United Nations. EPA is working on strategies to address releases of multiple pollutants using a new approach to air pollution control known as “clear skies.” We hope to make progress in remediation to reduce concentrations of pollutants in fish tissue. Thank you for the opportunity to address your gathering.

Note: these remarks were presented by video.

II. Guest Speaker

Trends in Chemical Pollutants in Fish.

Usha Varanasi, Northwest Fisheries Science Center

The National Oceanic and Atmospheric Administration (NOAA) manages living marine resources, including fish, marine mammals, and sea turtles, in all federal waters off the U.S. coast. This is a huge area, 3.4 million square nautical miles, spans a variety of ecosystems from arctic to tropical, and is home to over 900 species of fish and invertebrates that are caught for commercial, recreational, and/or subsistence purposes.

Fish are an important source of food, employment, and revenue, and are critical components of marine ecosystems. As a food source, fish are particularly important and unique; they are the primary source of animal protein for over 1 billion people and are largely harvested from the wild. While there are many benefits of eating fish, accumulation of pollutants, toxic chemicals as well as natural toxicants (e.g., harmful algal blooms) in fish can pose some risks to consumers.

NOAA is concerned about the health of living marine resources, as well as consumers of these valuable resources. As a result, NOAA conducts research on the accumulation and impact of pollutants, toxic chemicals as well as natural toxicants, on fishery resources.

Thousands of chemicals are produced and used routinely in industrialized and developing nations. Many of these chemicals eventually find their way into the ocean. Studying toxic chemicals is important because they affect both the safety of seafood that we eat and fish development, diseases, reproduction, and survival. Science can provide the information we need to assess benefits and risks associated with these pollutants and make critical management decisions (e.g., when to close or open a fishery, post a health advisory, or modify effluent discharge guidelines).

When investigating these pollutants, it is critical to determine the specific properties of key compounds and how they interact with species of interest. For example, research in the late 1970s at NOAA's Northwest Fisheries Science Center found that polycyclic aromatic hydrocarbons (PAHs) accumulate in the tissues of invertebrates (e.g., mollusks and crabs) but not fish; this is in contrast to organochlorines and many metals that do accumulate in fish. Fish, like other vertebrates, metabolize PAHs quickly and efficiently in the liver to detoxify them. They readily convert most hydrocarbons to metabolites that are eliminated into bile and out of their bodies.

It is also critical to develop and use methods that provide sufficient information, but that are not unnecessarily sophisticated. This enables techniques to be readily transferred and applied quickly to consumer safety issues (e.g., impacts of oil spills or harmful algal blooms on fishery resources).

While contaminants exist to some degree in all of our nation's waters, specific trends tend to vary by region due to various physical, biological, and human use characteristics. Nationally and regionally, federal, state, and tribal agencies are conducting monitoring programs to determine the extent and impact of contaminants on coastal and estuarine areas. Results from NOAA's national benthic surveillance program, indicate that, in general, legacy pollutants (e.g., DDT and PCBs) are decreasing, trace metals are more or less constant, and many chemicals, particularly those that are human-made, are highly concentrated near cities. Data also indicate that PAHs and other non-point source pollutants are increasing in a number of areas.

Long-term monitoring of contaminant levels and investigation into the impacts of non-point source pollutants on fishery resources are key. Data from these programs are used to determine trends in our nation's waters and fishery resources. Historically, however, it has been difficult for agencies to commit to consistent long-term monitoring programs. As part of long-term monitoring programs, it has become increasingly important to investigate the full suite of non-point source pollutants, such as PAHs and pharmaceuticals, as well as mixtures of pollutants and their cumulative affect on species.

Credible, rigorous, and objective science; long-term monitoring of legacy and non-point source pollutants; the development of testing methods that provide accurate and quick results; and efficient and effective communication of information to fisheries users will help ensure that the appropriate balance of benefits and risks is made with regard to the consumption of valuable fish and invertebrate resources. Continued research to better understand pollutants and their impacts on living marine resources is critical to the sustainability of the nation's fisheries.

References:

National Oceanic and Atmospheric Administration's National Status and Trends Program.
Puget Sound Ambient Monitoring Program
NOAA's Northwest Fisheries Science Center Environmental Conservation Division

Andy Smith: What is NOAA doing to look at pharmaceuticals in fish?

Response: NOAA is currently investigating a number of non-point source pollutants, including agricultural pesticides and certain pharmaceuticals. Some compounds, such as caffeine, are of particular concern because of the high volume and frequency with which they are released into the environment.

III. Updates to the Forum

New Version of the Risk Communication Guidance.

Barbara A. Knuth, Cornell University

EPA is sponsoring a revision to the current guidance for risk communication, which was entitled *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume IV – Risk Communication*, EPA 823-R-95-001 and issued in March 1995.

The 1995 guidance was written largely for an agency audience. In recent years, more attention has been focused on the needs of other groups in risk communication. For example, the last Forum focused on risk communication. Also, the National Environmental Justice Advisory Committee (NEJAC), which advises EPA, has been discussing contaminants in fish. Such initiatives and groups have contributed to an interest in updating and expanding the guidance.

Several issues are being addressed in the revisions. It is important to ensure that risk communication is culturally appropriate. It is important to ensure that all partners are involved and to assess messages based on needs identified. It is important to help the partners take actions that can include eliminating the problem. We know it is important to acknowledge that contamination is not “acceptable.” The Guidance should not be perceived as condoning pollution or seeing warnings alone as an acceptable solution.


The document is being coordinated by Tetra Tech, Inc. as the lead technical consultant. Other consultants are John Hesse (retired from the Michigan Health Department), Judy Sheeshka, Barbara A. Knuth, Patrick West, and Amy D. Kyle. A group of stakeholders identified by Tetra Tech and EPA have reviewed the work plan and provided input.

The approach for the revised guidance includes an effort to produce targeted modules that communities can use. Community partners have different needs. Risk communication modules can be targeted to help address these specific needs.

The guidance will emphasize community involvement and also better explain links to other phases of the risk analysis process. The product will continue to enhance the user-friendly set of risk communication outreach materials under development by the National Fish and Wildlife Contamination Program.

The final product will be web-based, rather than a paper report, to encourage tailored use of guidance appropriate to community needs. This should allow people to find helpful tools with a few clicks.

A current prototype is shown below.



- Current News & Events
- National Listing of Advisories
- Consumption Advice
- National Guidance
- Reports and Chemical Fact Sheets
- Press Releases, Letters, Brochures, and Other Materials
- Contacts
- State Data Entry (Password Required)
- Links

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 Risk Communication Guidance Document

Risk Communication Guidance Document

- [Section 1: Risk Communication as a Process of Empowering Communities to Deal with a Contaminated Environment](#)
- [Section 2: Working with Communities: Key Issues for Technical Assessment and Formulating Advice](#)
- [Section 3: Defining What the Risk Communication Program is Supposed to Achieve \(If you don't know where you'd like to end up, any road will do ...\)](#)
- [Section 4: Assessing the Community's Communication Needs updated](#)
- [Section 5: Deciding What You Want to Say and How to Say It: Designing and Implementing your Communication Strategy updated](#)
- [Section 6: How Do you Know If You're Headed in the Right Direction? Evaluate!](#)

The stakeholders advised us to keep the concise risk communication framework while adding case studies to illustrate important points. These can draw on real situations. They also requested that the product provide techniques for applying the framework to different situations and that it be realistic in its assumptions about funding, time, and staffing. All phases of the process are limited by resources and staffing. The stakeholders also wanted a discussion of fish consumption benefits. The consultants are working on a design.

The advantages of a web-based approach are that the guidance is more accessible and it may be less daunting than a large document. Moreover, materials may be developed for specific type of audiences. The materials can be modified and updated easily. This allows the format to become issue-oriented, based on the path a user takes, rather than process-oriented. There are some possible disadvantages, including accessibility only to those with web access. Stakeholders felt that this is a diminishing concern. Also, the document will need to be updated.

The next steps will be to complete all sections, links, information boxes, etc. The stakeholder work group will review the results and be involved in developing case studies.

Update on TMDLs and Fish Consumption Advisories.

Jim Pendergast, US EPA

This presentation focuses primarily on total maximum daily loads for methyl mercury; the water quality criterion for methyl mercury and how this is related to total maximum daily loads (TMDLs); the relationship between fish consumption advisories and TMDLs; and US EPA's new TMDL Rule.

The water quality criterion for methyl mercury that was adopted by EPA in January 2001 specified levels in fish tissue, rather than water, for the first time. This was because, to protect people, it makes more sense to measure mercury in the fish that people eat than in the water. However, this approach raises technical issues. How do states use this new criterion for permitting and TMDLs? Because the new criterion is above the level of detection, this could lead to more permits and TMDLs, which presents a resource issue.

US EPA has decided not to require states to start updating their own standards to reflect the new water quality criterion for five years from the date of publication of the criterion. This would allow time to publish guidance for implementing the criterion. Though EPA is not pushing them to do so, some states are interested in adopting the criterion now.

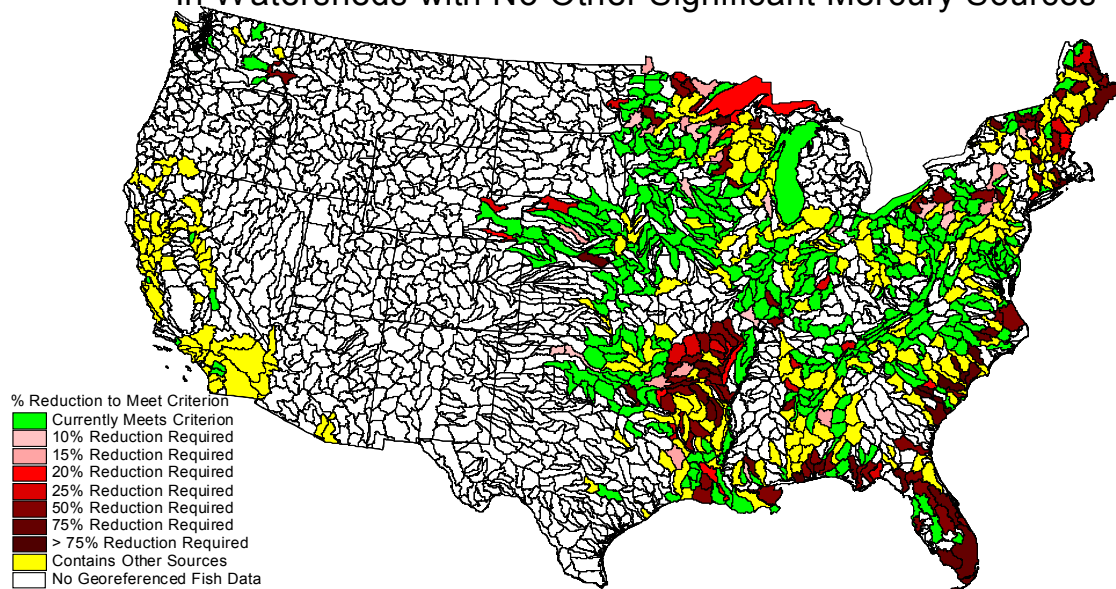
The key elements and issues to be addressed in the methyl mercury water criterion implementation guidance are:

- Water quality standards – translating methyl mercury to total mercury; flexibility for site specific criteria, expression of criterion (tissue or water); variances and use attainability analyses. Site-specific flexibility for criteria may be appropriate in cases where states may have watersheds where people eat considerably more or less fish than the consumption rate for the EPA criterion.
- Defining impairment – It will be important to define “impairment.” What does this mean? Do you include all trophic levels; does size of fish matter; what are appropriate analytical methods?
- Approaches to TMDLs.
- Permitting, especially for small sources.

US EPA has also been asked whether they will allow states to convert the tissue-based criterion to a water-based number.

A lot of mercury in fish today has probably come from air deposition; there could be a statewide or national analysis for sources in some watersheds. The map below shows the estimated percent reductions in air deposition load necessary to meet new criterion. Reductions to be obtained through imposition of the MACT (maximum achievable control technology) standards required under Section 112 of the Clean Air Act can be overlaid with this. US EPA is now working on calculating the reductions in air deposition for each watershed so that it can determine where the MACT standards are sufficient.

Estimated Percent Reductions in Air Deposition Load Necessary to Meet New Methylmercury Criterion* In Watersheds with No Other Significant Mercury Sources



* States currently use water column concentration-based mercury water quality standards and would need to adopt fish tissue-based target levels in order to use this approach for mercury TMDLs. Additional reductions would be required to meet EPA national and most state fish advisory levels, which are often set below the methyl-mercury criterion.
Note: Watersheds highlighted yellow have "significant" mercury sources other than deposition, defined as where the total estimated load from Publicly Owned Treatment Works (POTWs) and pulp and paper mills is greater than 5% of estimated waterbody delivered mercury at a typical air deposition load (10 g/km²/yr), and/or where mercury cell chlor-alkali facilities, mercury mines, or significant past producer gold mines are present. See text of report for data sources for point source dischargers and mines.
Source: National Listing of Fish and Wildlife Advisories (NLFWA) Mercury Fish Tissue Database (June, 2001).

EPA issued guidance in 2000 that provides that states must list as impaired water bodies that have risk-based fish advisories based on water body specific data where the advisory uses the same the same risk basis as the WQS. This means that the advisory and WQS use the same type of data collection and same threshold value.

The guidance does not require states to list water bodies with advisories that were issued without site specific data. Statewide advisories do not by themselves trigger listings of water bodies as impaired.

If the threshold for an advisory is based on a 0.3 parts per million level of methyl mercury that the state had adopted as a WQS, then any time there was an advisory based on site specific data, this would be considered to be an exceedance of water quality standards, and the state would be expected to list this as an impaired water. But if state developed a statewide advisory as a precaution, based on limited data, then US EPA would not require that all of the water bodies included under the statewide advisory be considered to be impaired.

The 2000 guidance also shows a cross-walk between water body listings and the National Shellfish Sanitation Program growing area classifications.

The bottom line is that advisories are not always impairments. Impairments occur when a population is exposed to a greater than acceptable risk, considering mixtures and range of species and ages.

Advisories are issued to protect individuals including people who have higher consumption. They can be water body specific. Some are regional or statewide, some are size specific, and some are species specific. A state could meet the water quality standards and still have advisories for some people.

The water quality standards are based on certain assumptions – people who consume more fish than this could still have risk but not be in impaired water bodies.

More information is available at the TMDL home page at <http://www.epa.gov/owow/tmdl>

Question: Barry Moore, Maine. What is the basis for estimates on percent reductions? How does this map differ from mercury map program map?

Response: It is the same mercury map. Paul Cocca developed it. Reductions were based on comparing average fish tissue values in watersheds to 0.3 ppm and calculating percent reduction to achieve this, assuming a linear relationship between the mercury concentration in fish and the atmospheric deposition of mercury.

Barry Moore: Is a linear relationship realistic? We don't think so.

Response: A Florida Everglades study showed linear relationships between atmospheric loadings and concentrations in fish tissue once reductions reached steady state, using a model developed for the power industry. Other models give pretty much the same result. Some data coming out of Canada suggests that the reduction may be much faster but still linear.

Don Axelrad, Florida: The model was developed by EPA and Florida Department of Environmental Protection as well as EPRI. If you consider the relative source contribution from marine fish based on national numbers, in Florida where there is a great deal of consumption of marine fish, we may calculate a 0 criterion for fresh water fish.

Response: We haven't considered this, but it is possible to occur.

IV. Reports from the Weekend Sessions

Methyl Mercury Contamination in Fish: Human Exposures and Case Reports.

Henry A. Anderson, Wisconsin Division of Public Health

You may remember that in the early days of the PCB advisories, one of the issues that came up with regard to the medical community was whether breastfeeding was advised.

We have, in other sessions, discussed asking physicians to tell patients about advisories, but when people come back with mercury values we are silent.

Now we have a biomarker for methyl mercury and the medical community is beginning to see patients who are ill and who have mercury measurements from hair, urine or blood. The question is, what does it mean and what do they do about it? The impetus for the workshop was to address how we can partner with the medical community to address these issues.

The workshop held on Saturday was sponsored by the US EPA, AFS, American Academy of Pediatrics, American College of Obstetricians and Gynecologists, Association of Occupational and Environmental Clinics, and Centers for Disease Control and Prevention.

The goal was to learn about the distribution of blood methyl mercury in the general population, including clinical experience. There is some published literature and some cases that have been

evaluated. We wanted to start to look at neuropsychological or neurological testing. How do we assess low exposures?

The group began with discussions of risks and benefits, toxicokinetics, available biomarkers, and which tests should be run for which types of exposures. There are elemental mercury and inorganic mercury exposures as well as methyl mercury, and it is important to physicians to know which test to order depending on route and source of exposure. There were presentations on chelation, where the issue is whether it is appropriate and when is it appropriate. The group discussed exposure assessment methodologies and heard reports from physicians including Dr. Jane Hightower and others from Boston, Wisconsin, and New Jersey. There was an evening presentation on German approaches and the results coming from the biomonitoring being conducted in the National Health and Nutrition Examination Survey (NHANES). The group discussed neuropsychological and neurological assessments. These have been the most sensitive endpoints. How do we gather information? What are appropriate risk communication and outreach methods?

Regarding the distribution of blood methyl mercury concentrations in the general US population, national data available are from the Centers for Disease Control NHANES study. The 1999-2000 NHANES only covers women (16-49) and children (1-5) for mercury (e.g., blood, hair, urine). This is a significant limitation. The blood mercury data indicate 7.8% of women are above EPA's reference dose (for blood) of 5.8 $\mu\text{g/L}$ [1]. It is not surprising, but the study found that fish consumption correlated well with blood mercury (For women who ate less than one fish meal a week, only 2% were above 5.8 while 15% of those who ate two meals a week were above.)

The group recommends that mercury become a core biomarker measured for all populations. The NHANES group reported that they are moving toward analyzing all blood samples collected for lead for mercury as well. The group also felt it would be important to look at the health status information and relate it to the mercury biomarkers

The group discussed cases of elevated methyl mercury exposures. There are reports of fish consumption that are related to blood mercury exceeding 50 $\mu\text{g/L}$. If people start looking, we may well find more of these. Now we need to address what this means. We need to define advice for folks with elevated levels. In the past, we have focused on subsistence users as an at risk population. We now need to consider high end consumers who have no cost boundaries and don't like bones in their fish, who purchase steak type fish. In Dr. Hightower's study, people were frequently eating sushi, tuna, swordfish, and other finfish with known high levels of mercury. We need to get together clinical guidelines and treatment guidelines from the professional associations. Targeted outreach for at risk populations is also needed.

With regard to neuropsychological impacts, though mercury is likely to cause effects, there is no signature neurological effect pattern to define toxicity and no simple test to run. Protocols need to be developed. What does a physician do? What kinds of tests are most likely to be useful? Guidance on these questions also needs to come from professional associations.

Next steps are to build effective partnerships, including consortia between governmental and non-governmental entities. More research is needed on cardiovascular effects in adults. Greater public and professional communication of mercury exposures hazards and prevention methods are needed. It would be important to better integrate fish consumption advice (between the states and the federal agencies) to speak with a single voice. Funding is a key issue.

Advisories for Methyl Mercury: Approaches.

Amy D. Kyle, University of California Berkeley

The conference steering committee developed a short work sheet including information about how states and tribes develop advisories for methyl mercury. Program managers for 39 states and four tribes completed the worksheet before or during the forum.

The worksheet included four types of advisories:

- Advisories for no fish consumption that apply to the general population (not including any identified sensitive subpopulations);

- Advisories for restricted fish consumption that apply to the general population (not including any identified sensitive subpopulations);

- Advisories for no fish consumption that apply to an identified sensitive subpopulation(s);

- Advisories for restricted fish consumption that apply to an identified sensitive subpopulation(s).

Mercury concentrations in fish that trigger advisories for no fish consumption for the general population ranged from 0.5 to 2.88 parts per million (ppm). Fifteen states and three tribes reported issuing advisories of this type.

Mercury concentrations in fish that trigger advisories for no fish consumption for an identified sensitive population ranged from 0.25 to 1.5 parts per million (ppm). Twenty three states reported issuing advisories of this type.

Mercury concentrations in fish that trigger advisories for restricted fish consumption for the general population ranged from 0.59 to 1 parts per million (ppm). Twenty eight states and two tribes reported issuing advisories of this type. The provisions varied considerably, with the allowable number of meals varying from 12 to 96 and the allowable meal size varying from 3 to 16 ounces. The total allowable methyl mercury that could be consumed following this type of advisory ranged from 0.48 to 7.7 milligrams per year.

Mercury concentrations in fish that trigger advisories for restricted fish consumption for an identified sensitive population ranged from 0.25 to 1.5 parts per million (ppm) and were issued by 23 states. The allowable number of meals ranged from 12 to 104. The allowable total amount of methyl mercury ranged from 1.37 to 47.4 milligrams per year.

V. Advisories for Commercial Fish

Report on the Advisory Panel to the Food and Drug Administration on Mercury Advisories.

H. Vasken Aposhian, University of Arizona

The talk addresses the discussions of the Food and Drug Administration Food Advisory Committee on Methyl Mercury, held July 23-25, 2002.

The charge to committee was to evaluate in light of all the relevant information about potential consumption exposures, population body burdens, hazard, and consumer measures whether the advisory for commercial fish is protective of the general public. Put more simply, does the FDA advisory provide adequate protection for pregnant women?

Question No. 1 was: Has the agency adequacy addressed and appropriately considered all the relevant actors and information that bear upon the elaboration of a consumer advisory on fish consumption? Answer: No. Are any factors not relevant? Answer: No. Are there additional factors that would be relevant? Answer: Yes.

There was some concern about a lack of transparency about the data that the FDA has used in the past. A statement from the chairman was that, "The FDA should publish its risk assessment in peer reviewed literature and indeed other organizations that have competing models ought to do the same and let the scientific community evaluate it." The group was also concerned about exposure of children to canned tuna fish and exposure of women.

Question No. 2: Should the FDA advisory have specifically advised pregnant women to avoid any other fish species not specifically mentioned and, if so, what would be the scientific rationale?

Consensus response was: Yes. The panel was surprised to learn that 27% of seafood consumed by American people is canned tuna. There was a concern about how to transfer information to women and children at risk. The information pamphlets by the states of Wisconsin, Minnesota, and Maine were very simple and clear. The Committee wanted to see better communication with people at risk for canned tuna.

Question 3: Should the agency issue a fish listing as an adjunct to the advisory to clarify what is meant? Answer: Yes

Should the agency revise its consumer advisory to make explicit that the 12 ounce per week includes all sources of fish, both recreational and commercial? Answer: Yes.

Should the agency increase its monitoring of methyl mercury in commercial fish in order to keep this advice current? Answer: Yes. FDA has not done much monitoring of canned tuna, which they say is because there isn't enough money. Other data are available. The American Tuna Association said every batch that is processed has a methyl mercury determination done and records are kept. The FDA has apparently never asked to see those records.

The state of Florida has performed some testing and reported results that exceed one ppm. The FDA action level is 1 ppm. One value of 1.238 was from a low sodium can of a type that should be eaten by those with high blood pressure. This presents a concern.

The reference levels used by various agencies continue to differ.

His involvement began in 1995 during interagency discussions. EPA via act of Congress got a study by the National Academy of Sciences (NAS) to determine which the appropriate level was, and the NAS concluded that it should be at the level set by EPA, at 0.1 [2]. This was two to three years ago. No one on committee felt people should not eat fish. Fish is good for people. It is very important that FDA communicate with women about how much canned tuna they should eat. Children are the future of this country.

FDA Consumer Advisory for Methyl Mercury.

Philip Spiller, US Food and Drug Administration

FDA has issued one advisory for seafood and that is for methyl mercury. It is still a work in progress. The federal advisory is national and uniform in scope. The mission of FDA is to address food in interstate commerce, not recreational/subsistence uses of fish.

Three major decisions are needed to devise an advisory: Who to target? What outcome are we seeking in the target population? How do we structure advisory to achieve the desired outcome?

For adults, the threshold for effects is 50 ppm in hair. Recent studies in the Seychelles and Faroe Islands show levels of 5 to 7 ppm. In the United States, the average adult hair concentration is 0.2 ppm. Some people may be consuming more mercury than recommended under the FDA acceptable daily intake level, but so far they have been too few to detect through biomonitoring such as that conducted in NHANES (National Health and Nutritional Examination Survey by CDC.) Based on these factors, FDA did not see adult population as urgent priority for action at national level. This does not mean they cannot re-think this based on new data. It also does not mean that on a regional basis, the adult population would not be an appropriate target for an advisory.

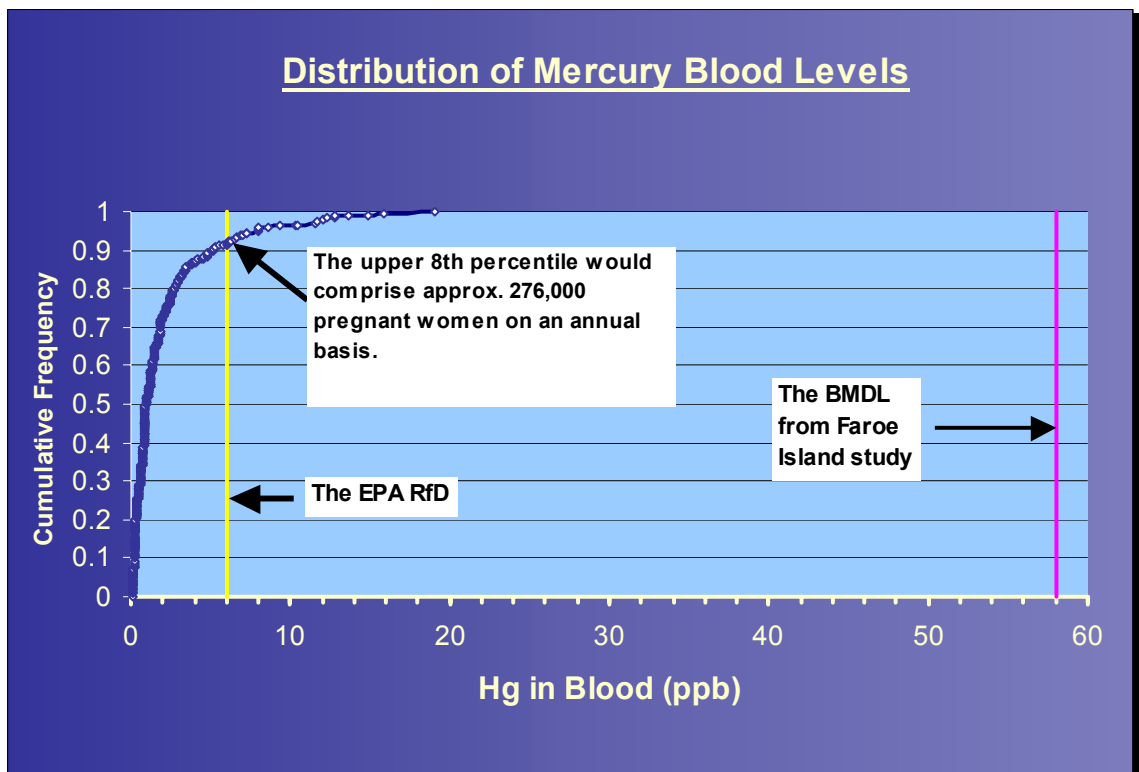
FDA decided to target the fetus. The Seychelles Island study did not detect effects [3, 4] [5] [6] [7], while the Faroe Islands study did [8-13]. The Faroe Island study did report effects at levels lower than those known to cause effects in adults. US EPA has used this study. Both have been questioned. ATSDR relied on the Seychelles study.

In July 2000, after a review, the National Academy of Sciences said that the Faroe Islands study should be used because of questions about Seychelles [2]. Other countries appear to be hedging bets and take into account both studies.

Faced with this ambiguity, FDA decided to take a prudent course and issue a consumer advisory to protect the fetus as a target population. The next question was what outcome should be sought via the advisory. One option would be to set a goal of keeping exposure below highest no effect level from Seychelles and Faroe Islands. That level of exposure is hard to reach, even without an advisory and would be the equivalent of one fish meal per day with fish containing five times the amount in commercial fish average. This is a 98th percentile consumer.

Another option would be to keep exposure below a worst case acceptable daily intake (ADI)-type level. The acceptable daily intake was developed by the FDA before the Seychelles or Faroe Islands studies were available. It is still applicable to general population but would not be relevant to the fetus if the fetus was more sensitive than the adult. ATSDR developed a daily

intake level, the Minimal Risk Level (MRL), which would be relevant for the fetus. The EPA reference dose is also relevant to pre-natal exposures and is more conservative, representing the worst case. According to the most recent data available from NHANES, eight percent of women of child bearing age are consuming above the worst case.



FDA decided to issue a single advisory that would be simple to follow and that would minimize impact on the majority whose consumption is not at issue. If advisory is followed, FDA calculated that everyone within the target population would have margin of safety of at least 10. It would move everyone to left of yellow line (on the previous graph). Most people do not need to modify behavior. It creates as little disruption as possible and targets as few fish as possible. The message is to avoid highest species, which are named; that it is acceptable to eat up to 12 oz per week of a variety of fish; and that one should check local advisories for recreational and subsistence advisories.

Michael Bender, Vermont: Why is FDA's level of safety less than EPA? Why does FDA not test tuna?

Response: We keep hearing a steady concern over the years that it is a bad thing that FDA's ADI differs from EPA's RfD. The idea of having different numbers for adults and fetus is not necessarily bad. We need to have a strategy for sensitive populations.

Kory Groetsch, Great Lakes Indian Fish and Wildlife Commission: People are aware of mercury issue but can't tell which fish will have higher v. lower levels of mercury. Has FDA considered labeling to allow consumer to choose?

Response: yes – nothing has been ruled out. The standards for requiring labeling are strict. It is a challenge to make sure an advisory becomes well known. The FDA advisory has been out since the mid 1990s and been published in sources such as magazines.

H. Vasken Aposian: When you buy a candy bar – you can look at the number of calories. FDA now insists on labeling of calories on foodstuffs – why not put on some kind of notice for mercury?

Responses: Nutritional labeling is covered by a different law; other labeling has more rigorous studies mandated.

Eric Uram, Sierra Club. The ADI places significant weight on the recommendation for two fish meals or more per week from the American Heart Association. It now appears that eating less fish will get you same benefit. Has FDA tried to quantify benefits for seafood and resolve this issue?

Question: The data for the tile fish came from two quadrants along the Texas Louisiana border – probably golden tilefish. Other data collected was 0.1 ppm total Hg in survey collected along Atlantic coast. Would you consider de-listing this and looking at data?

Response: We would be receptive to this.

Dan Kusnierz, Penobscot Indian Nation. Tribes are struggling with message of benefits and risks from fish including cultural benefits. For subsistence fishing – people are going out there and catching fish themselves. A new at-risk population is people buying fish from grocery stores because of messages that eating fish is good for you. Now we are finding high levels of mercury in blood of these people. The communication strategy does not seem to be working for at least some people. There are also implications for people who stop eating traditional foods and buy fish.

Response – one of the recommendations was to do a better job of extending advisory beyond commercial fish because people do not necessarily distinguish between these and to build in messages about subsistence and recreational fish.

Elaine Krueger – Massachusetts issued an updated advisory last year that included advice from the federal level and included advice on tuna. We can appreciate good work done by federal agencies but have to give advice on the phone to people and can't always wait on the federal response. States have issued advisories regarding commercial fish. How many states have commercial advisories?

Response: About four.

Integrated Public Health Messages for Sport Fish and Commercial Seafood.

Henry A. Anderson, Wisconsin Division of Public Health

Understandably, it is confusing to see advice about mercury in fish on one side (the state or recreational side) but not the other (the federal or commercial side.) Communication is a local activity. We need to communicate at local level.

A survey was conducted in 12 states as a joint effort of the states of Wisconsin and Maine, using random digit dialing. Other states included California, Montana, Minnesota, New Mexico, Louisiana, Arkansas, Florida, North Carolina, New Jersey, and Connecticut. Respondents were asked about their fish consumption.

For women, average sport fish consumption was about 4 fish meals a year; 11 for shellfish; and 28 for fish fillets and tuna (combined). Even as few as 4 meals can be critical for PCBs, which are low in commercial fish. Concentrations of mercury in sport fish can be comparable to commercial.





Hair mercury was sampled, and 410 samples were obtained. The amount of mercury in hair was related to fish consumption.

Wisconsin has a complex system of advisories. In 2000, 1200 water segments were tested, and advisories were issued for 340. The states moved to general statewide guidelines plus site specific advice for 92 hot spots where more stringent advice is needed, and the advice addresses both commercial and sport caught fish.

The guide to eating fish from Wisconsin suggests:

- One meal per week of canned light tuna and one meal per week of either key sport caught fish or any commercial fish;
- One meal per month of higher mercury sport caught fish;
- No consumption for the list of commercial fish on the FDA advisory to never eat.

A Woman and Child's Guide to Eating Fish from Wisconsin (2002) – Includes sport and commercial fish.





















WEEKLY	1 meal per WEEK  of Canned Light Tuna** (6 oz. can = 1 meal)	AND	 OF EITHER	OR	Bluegill, sunfish, black crappie, white crappie, yellow perch, bullheads Any commercial fish (fish you buy in a store or restaurant)
MONTHLY	1 meal per MONTH  OF	Any sport fish species (sport fish are any fish you catch or are given, such as bass, walleye, northern, perch, or crappie). Sport fish are NOT fish you purchase in a store or restaurant.			
NEVER	NEVER EAT  ANY	SWORDFISH, SHARK, KING MACKEREL, OR TILEFISH			

The advisory includes additional information about ocean species and provides pictures of both sport caught fish and commercial fish that are low in mercury.

Choose Fish Low in Mercury!

Guidelines below are for fish from Wisconsin lakes, ponds, and rivers and for fish bought in restaurants and stores.

Fish is good for you. Eat fish low in mercury!

SPORT CAUGHT: Fish You Catch		COMMERCIAL: Fish You Buy	
BLUEGILL  Mercury Level: <input checked="" type="radio"/> LOW <input type="radio"/> MED <input type="radio"/> HIGH	WHITE CRAPPIE  Mercury Level: <input checked="" type="radio"/> LOW <input type="radio"/> MED <input type="radio"/> HIGH	ATLANTIC SALMON  Mercury Level: <input checked="" type="radio"/> LOW <input type="radio"/> MED <input type="radio"/> HIGH	SHELLFISH (such as shrimp, scallops or lobster)  Mercury Level: <input checked="" type="radio"/> LOW <input type="radio"/> MED <input type="radio"/> HIGH
YELLOW PERCH  Mercury Level: <input checked="" type="radio"/> LOW <input type="radio"/> MED <input type="radio"/> HIGH	BLACK CRAPPIE  Mercury Level: <input checked="" type="radio"/> LOW <input type="radio"/> MED <input type="radio"/> HIGH	FLATFISH & FLOUNDERS  Mercury Level: <input checked="" type="radio"/> LOW <input type="radio"/> MED <input type="radio"/> HIGH	COD, OCEAN PERCH & HADDOCK  Mercury Level: <input checked="" type="radio"/> LOW <input type="radio"/> MED <input type="radio"/> HIGH
SMALLMOUTH BASS  Mercury Level: <input type="radio"/> LOW <input checked="" type="radio"/> MED <input type="radio"/> HIGH	CATFISH  Mercury Level: <input type="radio"/> LOW <input checked="" type="radio"/> MED <input type="radio"/> HIGH	CANNED "LIGHT" TUNA  Mercury Level: <input checked="" type="radio"/> LOW <input type="radio"/> MED <input type="radio"/> HIGH	CANNED "WHITE" TUNA  Mercury Level: <input type="radio"/> LOW <input checked="" type="radio"/> MED <input type="radio"/> HIGH
LARGEMOUTH BASS  Mercury Level: <input type="radio"/> LOW <input checked="" type="radio"/> MED <input type="radio"/> HIGH	CARP  Mercury Level: <input type="radio"/> LOW <input checked="" type="radio"/> MED <input type="radio"/> HIGH	HALIBUT  Mercury Level: <input type="radio"/> LOW <input checked="" type="radio"/> MED <input type="radio"/> HIGH	TUNA  Mercury Level: <input type="radio"/> LOW <input checked="" type="radio"/> MED <input type="radio"/> HIGH
NORTHERN PIKE  Mercury Level: <input type="radio"/> LOW <input type="radio"/> MED <input checked="" type="radio"/> HIGH	WALLEYE  Mercury Level: <input type="radio"/> LOW <input type="radio"/> MED <input checked="" type="radio"/> HIGH	SWORDFISH  Mercury Level: <input type="radio"/> LOW <input type="radio"/> MED <input checked="" type="radio"/> HIGH	SHARK  Mercury Level: <input type="radio"/> LOW <input type="radio"/> MED <input checked="" type="radio"/> HIGH

People like to have pictures of what it looks like when they buy it in the store.

Any successful program has to be a joint activity between state health and environment agencies. The environmental agency was responsible for comprehensive sport fish monitoring species, size, and location. The health agency was responsible for human biomonitoring, health outcomes, and advisory evaluation. There are little state general revenues for this, so the work was largely supported by federal sources.

The survey also asked about awareness of mercury. Awareness varied considerably by state but averaged about 20% with a high of 32% in Maine and a low of 8 to 9% in Montana, New Mexico, and California. States with longer established programs have higher awareness.

The group concludes that increased commercial fish monitored designed to assist in advisory development is needed, as is increased human biomonitoring and continued health effects research, particularly for cardio vascular effects.

Consumer Advisory for Commercial Fish.

Andy Smith, Maine Department of Human Services

The first question is, why issue advisories for commercial fish? The main reason is that commercial fish are most commonly consumed. Women want to know about the commercial fish they were eating. Only about 20% of women in Maine reported eating sport caught fish. The limited data available for Maine suggest that higher hair mercury levels were largely associated with eating commercial fish.

A guiding principle was to avoid confusion and increase consistency. It is difficult to inform people and gain behavior change with differing messages. To gain buy-in from medical folks, the message needs to be clear. A second objective was to redirect fish consumption toward fish lower in mercury.

Ocean Fish and Shellfish	
❖ Striped bass and bluefish	Limit: For everyone, 2 meals per month
❖ Swordfish, shark, tilefish and king mackerel	Limit: • For pregnant and nursing women, women who may get pregnant, and children under 8, NO meals • For all others, 2 meals per month
❖ Canned tuna (the 6 ounce size)	Limit: • For pregnant and nursing women, women who may get pregnant, and children under 8, 1 can of "white" or 2 cans of "light" tuna per week
"White" tuna has more mercury than "light" tuna.	No limits for all others as part of a balanced diet
❖ All other ocean fish and shellfish including canned fish and shellfish	Limit: • For pregnant and nursing women, women who may get pregnant, and children under 8, 2 meals per week
	No limits for all others as part of a balanced diet

The advisory differs from FDA's advice in certain ways. It addresses canned tuna and separates out light compared to white canned tuna, as the latter is about twice as high in mercury, and suggests no more than 1 can of white or two cans of light tuna a week for women or children under eight. (The FDA advisory does not include canned tuna.)

The advisory also provides information for the general population (in addition to women and children) and recommends no more than two meals per month of swordfish, shark, tilefish, and king mackerel for the general public.

The strategy for risk communication focused on developing a brochure using focus groups and a health literacy expert and posters for waiting rooms and exam rooms at clinics. It shows commercial fish in forms found in the market and the sport fish in forms brought out of the water. (So, commercial fish are depicted in a cleaned and packaged form and sport fish are depicted in a whole form.) Maine is targeting women through WIC (woman infant children) programs and clinics. The strategy also targets fishing households with kids by matching birth certificates and fishing licenses.

Next steps involve continuing to improve materials. The ultimate measure of effectiveness would be increased awareness of safe eating guidelines, changed consumption behavior and decreased hair mercury levels. (It would be a failure to reduce both hair mercury levels and consumption.)

The Context for Connecticut's Seafood Advisory.

Gary Ginsberg, State of Connecticut

The State had been issuing recreational advisories since 1980s. The principal sampling for mercury in lakes occurred in 1996-1997. This resulted in a statewide freshwater advisory. Four water bodies were particularly high, with average concentrations in bass above 1 ppm.

People would ask about commercial fish, so Connecticut developed an advisory to respond to questions. They decided to look at concentrations in commercial fish and how these compared to sport caught fish. Swordfish and shark were greater than 1 ppm; tuna steak was generally from 0.3 to 0.5 ppm. Published results for canned tuna [14] reported 0.1 ppm in chunk or chunk light and 0.3 ppm in chunk white or solid white tuna.

The point of departure is around 0.2 ppm, and these numbers were in the same ballpark. This convinced the administration that it was appropriate to move forward. Infrequent consumption of swordfish/shark (once per month) is in the range of the methyl mercury RfD. This leads to a do-not-eat category. They do not have a category for consumption less frequent than once per month. Frequent consumption of canned tuna (e.g., 2 or more times per week) is in the range of the RfD and would lead to an advisory of one to two meals per week for the high risk population only.

They considered whether consumption of commercial fish could be contributing to mercury concentrations found in hair. In NHANES for 1999 (702 women), the 90th percentile is at 1.4 ppm, which is around the range of the RfD.

A simulation of seafood consumption by FDA [15] matched consumption rates and mercury concentrations based only on 24 species (which suggests that others are not important). The

study shows tuna is around 30% on average, which is by far the largest single species. Swordfish and shark contribute much less overall. Pollock and cod are also contributors.

A New Jersey study measured mercury in pregnant women [16] and found that 9.5% were between 1 and 2 ppm in hair. 10-15% ingested more than the RfD. Fish consumption patterns were only weakly correlated with Hg.

A Connecticut mercury biomonitoring data study (EPA Mercury Advisory Awareness Study, 2000) found that the results for hair mercury were higher than other states and may be influenced by small numbers. The study included 17 women from Connecticut, 18-45 yrs old, and found a mean hair mercury level of 1.0 ppm (+/- 0.8 ppm.) The fish intake data was sketchy, but commercial fish consumption was much more common than sport fish.

The Connecticut Commercial Advisory says that high risk groups should avoid swordfish and shark, while others can eat 1 to 2 meals per month. For canned tuna and other commercial fish the recommended consumption is 1-2 meals per week for high risk groups and unlimited for others. Species identified as being low in mercury and PCBs include haddock, cod, flounder, and salmon.

A question to consider is whether there should be a commercial advisory for PCBs. Striped bass and bluefish have elevated PCBs. Connecticut has recreational but no commercial advisory for these species. They are uncommon in marketplace in Connecticut.

LuAnne Williams, North Carolina: Would like to thanks folks from Wisconsin and Maine for initiating the multi state survey, which North Carolina benefited from. This led to changes in approach, leading to more focus on health care providers. They have advice statements that recommend two meals a week of fish and provide a list of safer species. They recommend that people avoid seven types of fish.

Roseanne Lorenzana, EPA Region X: There has been a study funded by EPA of fish consumption in Asian Americans in 1999 that show high level of consumption of commercial fish, though species are not primarily tuna fish or pollock. What is the monitoring of these kinds of fish? Are there state advisories that focus on these populations?

Response: Henry Anderson: if people are purchasing fish there is probably little testing. Wisconsin does have outreach to growing Asian populations. There are difficulties in defining species in common terms. They are also emphasizing cooking approaches.