Final Report

Program Review of the Great Lakes Fish Monitoring Program (GLFMP)

- Technical review of goals, monitoring, and research activities of the GLFMP (1970-2005)
- Recommendations for the future operation and direction of the program.

Review Panel Members:

Robert Day, Michigan Department of Environmental Quality
Patricia McCann, Minnesota Department of Public Health
Ronald Hites, Indiana University
Christopher Schmitt, USGS - Columbia Environmental Research Center
Leanne Stahl, USEPA Office of Water
Tony Forti, New York State Department of Health

Chicago, IL
February 7-8, 2005

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I. Program Review Mission

The U.S. Environmental Protection Agency's Great Lakes National Program Office (GLNPO) conducted a program review of the Great Lakes Fish Monitoring Program. GLNPO developed a technical charge to provide background and specific instructions for the program review panel. The overall goals of the review were to enhance the quality and validity of the program, ensure the data generated under the program meet the needs of the stakeholders, and to ensure any future decisions based on this program would have a sound, credible basis.

The program review was held February 7-8, 2005. Prior to the review, the participants were provided with a briefing book containing specific information about the program review, including an agenda, a technical charge for the panelists, and reference information about the GLFMP. In addition, a series of presentations were provided on the first day of the review. These presentations provided an historical overview of the program, an overview of the current program (including a summary of the trends in Great Lakes fish contaminants), a discussion of the quality assurance program, details of the data management process, and information from State personnel currently using data generated by the program. Several opportunities also were provided during the two-day meeting to ask questions of the presenters and GLNPO staff supporting the program. Panel members were encouraged to contact the program review coordinators if they felt that any additional information or materials were necessary to complete their review.

The panel developed a series of ten recommendations during the meeting. In addition, GLNPO requested written submissions of each panelist's comments, suggestions, and recommendations. Panelists were asked to include general comments that address the questions raised in the technical charge, in addition to any specific comments on the program.

II. Great Lakes Fish Monitoring Program Background

In 1977, GLNPO began collaborating with the US Geological Survey Biological Research Division (USGS-BRD) on a fish monitoring effort to measure the contaminant levels of various organic substances in lake trout in the Great Lakes ecosystem. This effort was previously managed by USGS since the mid-1960s. The study was further modified in 1980, when the US EPA, US Food and Drug Administration (FDA), USGS-BRD, and the eight Great Lakes States began a cooperative effort to monitor and better define the fish contaminant problem in the Great Lakes. The project is currently implemented by GLNPO with cooperation from the Great Lakes States, selected State agencies, and Native American Tribes.

Game fish and predatory fish are collected from the five Great Lakes. Game fish are collected by the eight states surrounding the Great Lakes (Ohio, Illinois, Michigan, New York, Pennsylvania, Wisconsin, Minnesota, and Indiana). Game fish include Coho and Chinook salmon in Lakes Michigan, Superior, Ontario, and Huron and rainbow trout in Lake Erie. Predatory fish are collected from all five Great Lakes on an annual basis. Predatory fish include lake trout in Lakes Michigan, Superior, Ontario, and Huron, and walleye in Lake Erie. The Great Lakes fish monitoring program (GLFMP) organizes collections through cooperative agreements with other agencies or by purchasing predatory fish from commercial fisherman.

Over the life of the GLFMP, a wide variety of metals and organic chemicals have been analyzed in fish samples collected in the Great Lakes Basin. The list of analytes has changed in response to both budgetary constraints and information about new and emerging contaminants. The

current list of analytes of interest consists of a wide variety of organic contaminants and mercury, a metal contaminant of specific concern in the Great Lakes.

The overall goals of the GLFMP include:

- to monitor temporal trends in bioaccumulative organic chemicals in the Great Lakes using top predator fish as biomonitors,
- to assess potential human exposure to organic contaminants found in these fish, and
- to provide information on new compounds of concern entering the lakes ecosystem.

The GLFMP goals are broken down further into two elements:

- Element 1: Open Lake Trend Monitoring
- Element 2: Game Fish Fillet Monitoring

Element 1 (Open Lake Trend Monitoring) is directed at monitoring contaminant trends in the open water of the Great Lakes, and assisting in evaluating the impacts of contaminants on the fishery. Element 2 (Game Fish Fillet Monitoring) is directed at monitoring potential human exposure to contaminants through consumption of popular sport species, as well as providing temporal trend data for top predator species, which have shorter exposures than the lake trout collected in Element 1. Data generated by the program are also used by States for their own programs including developing fish advisories.

III. Preamble

According to the Great Lakes Water Quality Agreement (GLWQA), the Great Lakes should be free of toxic substances that are harmful to fish and wildlife populations and the consumers of this biota. Annexes 1 (Specific Objectives), 2 (Remedial Action Plans and Lakewide Management Plans), 11 (Surveillance and Monitoring), and Annex 12 (Persistent Toxic Substances) set out actions to be taken by the Parties with the general intent of meeting these goals in the Great Lakes Basin. The GLFMP attempts to satisfy the GLWQA requirements.

IV. Great Lakes Fish Monitoring Program Review Panel Recommendations to GLNPO

A group of experts were gathered to produce a list of recommendations for the future of the Great Lake Fish Monitoring Program to be considered by EPA's Great Lakes National Program Office. The recommendations prepared by the review panel will be used by GLNPO to revise and enhance the GLMFP to better fit with current environmental conditions and better serve stakeholders. Each panel member signed a conflict of interest statement before joining the review panel in order to avoid any appearance of impropriety in re-competing the grant to analyze contaminant concentrations in Great Lakes fish for the GLFMP.

The following ten recommendations were collaboratively produced and ranked by the review panel.

1. Approve and release 1993-2003 data.
2. Establish the status and ensure the maintenance of the GLFMP historical sample archive.
3. Establish a GLFMP steering committee to guide the direction of the GLFMP and to allow for group decisions regarding minor changes that may need to be made to the program. The steering committee will include:
    a. GLFMP program officer

b. GLMFP principal investigator
c. GLNPO – MIRB branch chief
d. State representation
e. Tribal representation

4. Review and revise the analyte list, with particular emphasis on:
    a. Selection criteria for analytes
    b. Establishment of minimum detection limits
    c. Determination of how to best to handle non detected contaminants, particularly in regards to QA/QC
    d. Emerging contaminants (e.g. PBDEs)
5. Develop a procedure or protocol to move an emerging contaminant to the routine analyte list.
6. Establish a mechanism to enhance consistency of analytical labs.
7. Include and maintain routine check samples into the GLFMP.
8. Better define the goals and stakeholders of both Element 1 and Element 2 of the GLMFP.
9. Create an Element 3 of the GLFMP that will seek to develop an approach for documenting the occurrence of new and previously unrecognized contaminants in Great Lakes fish.
10. Conduct statistical power analysis on both Element 1 and Element 2 of the GLFMP in order to revise and/or develop Data Quality Objectives (DQO). Questions to be answered by power analysis should include;
    a. What is the current power of Element 1? (i.e., what differences can be detected using the current protocol, and how is this likely to change if concentrations decline in the future?)
    b. Can Element 2 be used as a trend program? (i.e., what differences can be detected by Element 2 in its present configuration?)
    c. What percent change should Element 1 determine to continue the current trend?
    d. Can the power of either or both elements be increased by incorporating additional data and information pertaining to the samples, such as fish age, size (length weight or both), gender, lipid content, and moisture content?

V. GLFMP Participants

1. GLFMP Review Panel Members

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•Candy Schrank, Wisconsin Bureau of Fisheries Management and Habitat protection, candy.schrank@dnr.state.wi.us.
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4. Program Review Coordinators

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VI. Meeting Summary

FEBRUARY 7, 2005 - PART 1

A series of presentations were provided during Day 1 of the review. A question and answer session followed each presentation. Copies of the presentations by each speaker are provided as an attachment to this summary. The following is a brief description of the presentations.
Gary Gulezian kicked off the meeting with a welcome to attendees and an overview of GLNPO's mission. Gary also emphasized the importance of the GLFMP data and its use in the Great Lakes Regional Collaboration process, a Presidential Executive Order signed in May 2004. The Great Lakes Regional Collaboration brings together a federal Task Force, the Great Lakes states, local communities, Tribes, regional bodies, and other interests in the Great Lakes region. The Great Lakes Framework calls for these parties to, within one year, design a strategy to restore and protect the Great Lakes now and into the future. Paul Horvatin reviewed the objectives of the program review. He discussed the technical charge and agenda. Paul mentioned that although GLNPO may not have the budget to address all of the recommendations provided by the panel, he encouraged the panel members to make their recommendations and allow GLNPO staff to evaluate them in light of budgetary constraints.

David DeVault, US Fish and Wildlife Service, gave the first presentation. Mr. DeVault provided an historical overview of the program.

Elizabeth Murphy, GLNPO, provided a presentation on the collection sites and current sampling program.

Sandy Hellman, GLNPO, provided a presentation on the location, format, and status of the historical data.

Deborah Swackhamer, University of Minnesota, provided an overview of the current program. Dr. Swackhamer presented results of the tissue analyses for a subset of the more current data. Please note that these data are not included in the attached copy of the presentation because the data are not yet finalized.

Louis Blume, GLNPO, provided an overview of GLNPO's quality management program and specifically discussed the quality program being implemented for the GLFMP.

Kenneth Klewin, GLNPO, provided a presentation on data storage and access to the fish monitoring data.

FEBRUARY 7, 2005- PART 2

Robert Day, Michigan Department of Environmental Quality (MDEQ), provided a presentation on the State of Michigan's fish monitoring program. Special emphasis was placed on recommendations given to MDEQ during their peer review in 2003.

Patricia McCann, the Minnesota Department of Public Health (MDPH), gave an overview of Minnesota's fish advisory program and how MDPH uses fish tissue data to calculate consumption advice.

Tony Forti, New York State Department of Health (NYSDPH), discussed fish advisory and monitoring programs in EPA Region 2 and how NYSDOH uses fish tissue data to calculate consumption advice.

FEBRUARY 8, 2005- PART 1: DISCUSSION OF TECHNICAL CHARGE

The day began with a review of the agenda. Due to time constraints that became obvious on the first day of the review, Leanne Stahl, US EPA Office of Water, gave a presentation originally scheduled for Day 1. Ms. Stahl provided a presentation on the National Lake Fish Tissue Study.

Following this presentation, the group discussed the technical charge questions. The stakeholders and participants were then provided an opportunity to present their recommendations to the review panel. The meeting ended with the discussion and provision of specific recommendations to GLNPO by the panel. These recommendations will be detailed in a report being developed by GLNPO. The following is a summary of the discussion that occurred during Day 2 of the review, excluding the discussion and provision of specific recommendations by the panel (February 8th, Part 2: Panel Discussion and Recommendations).

Elizabeth Murphy, GLNPO, commenced the discussion by noting that she receives many questions from states that collect coho and chinook salmon. She noted that many states believe

that because they are not finding statistically significant changes in dioxin and other contaminants of concern that they would prefer to go to a rolling schedule.

Bob Day stated that there are other issues related to coho regarding their population and availability for monitoring. He noted that the stocking levels for these fish have declined and that there are sampling sites in Lakes Michigan and Huron where required numbers of fish are difficult to locate.

Candy Shrank noted that coho are also declining in Lake Superior. She suggested that if you keep the schedule the same, you will have an opportunity to collect fish each year. She stated that GLNPO may want to continue the Element 2 program, but look at the number of fish needed.

Sandy Hellman discussed how Element 2 of the GLFMP was never designed to meet an objective involving interpretation of trends. She expressed concern that the data are being used to identify trends and inquired as to the validity of that data use. She noted that it is likely that only Lake Michigan has enough sampling sites to permit use of the data for evaluating trends.

David Devault noted that it is important to discuss the objectives of the program separately for Elements 1 and 2. He noted that in the past, FDA was doing the analysis for free, and therefore they collected the salmon to assist some of the Great Lakes States in their monitoring programs.

Tony Forti discussed the behavior of the salmon and their representativeness of lake ecosystems. The group discussed fish movement around the lake and how that affected representativeness and the required sample sizes.

Candy Shrank inquired about the last time the GLFMP data were analyzed in the context of estimating change over time and evaluating the effects of lipids and fish length. David Devault suggested that this was done in the 80s and suggested that these analyses need to be done before you can evaluate the program and redefine the objectives. Candy Shrank suggested that all of the Element 2 data need to be evaluated in the context of trends and then the program objectives could be further evaluated.

David Devault asked the States about their current data needs. He noted that because Element 2 was designed to assist some of the Great Lakes States with their programs, it is important to determine what information the States need now.

Bob Day stated that one objective is to monitor potential human exposure to fish tissue contaminants, but this objective is not being met, due to the delay in obtaining data.

Candy Shrank noted that the State of Wisconsin would be better able to use Element 2 fish contaminant information for individual fish as opposed to composites. She noted that she sees value in the trend analyses. Even if a significant trend is not occurring this information is still valuable. Ms. Shrank noted that she gets questions whether PCBs are still dropping, but does not know the answer.

Pat McCann asked if more is learned from the lake trout or the salmon. Bob Day noted that the inclusion of multiple species in the program is important.

Pat McCann noted that her needs from a human health perspective involve emerging contaminants. Historically, she added, they needed to know that contaminants of concern were going down. As far as adding information to the fish advisory program, she felt that the GLFMP

Element 2 data were not much of an aid except that they reinforce their own data. Ms. McCann felt that the question is "do we learn more about emerging contaminants and trends from coho" - sounds like we do. She asked if coho salmon are the right species and felt that this needed to be evaluated. She agreed that they cannot easily be collected.

Pete Redmon noted that when the program was initiated, the system was much different than it currently exists. He noted that it was time to reassess whether what is being done now fits the current picture and suggested a fisheries expert will be needed to support this evaluation.

David Devault agreed, and thought that GLNPO needed to start from the beginning and evaluate the questions that are pertinent in 2005. Then the two components of the program should be evaluated and either redesigned or perhaps involve a completely different monitoring approach.

Bob Day suggested that GLNPO may want to consider redesigning the trend analysis of Element 1 to address a longer time span, such as 10 years, as opposed to addressing changes each year. Sample sizes for this approach could then be estimated.

Candy Shrank noted that the current design of Element 2 does not take into account the lipid content or fish size. She noted that if you address this, changes in PCB concentrations may be able to be detected.

Chris Schmitt discussed analyses that could be done to address the representativeness of the sampling sites and refinements in the design that could be made, based on the results of these analyses.

David Devault expressed the need to publish the data in order to address these questions.

Sandy Hellman noted that the main reason publishing has not yet been done is that the data are in hard-copy format and have not been available in electronic format. She noted that, fortunately, most of the data are now in an Access database, so that these efforts may be able to be done. Elizabeth Murphy noted that Deb Swackhamer is writing a trend paper.

Matt Hudson stated that from a Tribal perspective, specifically those in the Lake Superior region, salmon is not a big part of what they are consuming. Their diet is more likely to contain lake trout, whitefish, and herring. He suggested that GLNPO may want to consider other species such as these.

Judy Beck noted that one of the troubling things is looking at all lakes in all years. She noted that she thinks we need to step back and look at what the uses have been and also review other monitoring work. Ms. Beck stated that she is a user of the coho data and, although it may not have originally been intended for trends, that is how it is being used. When she has been asked why these data are different than data being generated by States, she has explained that the GLFMP is using composites and that provides a different perspective than the State's data which are based on individual fish for the development of fish advisories. Ms. Beck noted that it would be great to have different monitoring programs on coordinated monitoring cycles. If this could be done, the final database could be richer.

Joan Coughlin asked if the trends and State fish advisory programs are mutually incompatible, and if so, GLNPO may need to maximize the most important components. Candy Shrank noted that it is not that you cannot use the information, but the lake trout data currently collected for trends cannot be used for fish advisories.

David Devault asked if there is still a need at the Federal level for an indicator for potential human exposure. Melissa Hulting noted that it is useful when discussing the links between other GLNPO programs, such as the Integrated Atmospheric Deposition Network (IADN) and reduction actions, such as the need to get rid of PCB transformers.

Sandy Hellman noted that Element 1 is designed to look at trends, but often SOLEC requires a fishability indicator and coho data (Element 2) are being used to look at trends. Paul Bertram noted that this information may be available from States and could be used instead of Element 2 and Bob Day agreed that he could provide that information for his State.

Melissa Hulting asked if data from States could be used to address objectives in Element 2. She stated that she was not aware of the original Element 3 involving near-shore monitoring, but noted its renewed importance in the context of sediment remediation projects.

Bob Day stated that the original design of Element 3 is likely not sufficient to judge remedial success. He suggested that you cannot use any of these programs to answer site-specific questions. He noted that you can control movements of caged fish, but that the current design involves fish that move around.

David Devault suggested that you can get at emerging chemical information and that, although fish do swim, they still reflect the area where you catch them.

Judy Beck noted that she is concerned with ending Element 2, given that they have been using the data. Louis Blume stated that he did not think anyone was proposing dropping Element 2, and that right now, the purpose is to provide information to the panel members. He did hear that other species may be of interest, for example to Tribes.

Mr. Blume expressed his concern that the analytical methodology for emerging contaminants needs to be addressed before they can be incorporated into a long-term monitoring program.

Pete Redmon recommended that archived samples may be used for this purpose and that this has been done in the past to evaluate PBDEs.

Korey Groetsch noted that it sounds as if Element 2 is not likely to bring large quantities of data to the States' fish advisory programs. He stated that the GLFMP could assist the States in evaluating uncertainty and assisting in designing the sampling design and frequency for their programs. .

Tom Hornshaw stated that Element 1 is doing what it is intending to do, but that Element 2 is not all that useful to him. He noted that if the purpose of Element 2 was to address human health, then that is what it should do. These data should not be used to evaluate trends. He noted an example where they tried to merge data from several projects, and the data were then misused. If we want to look at human health, we should design around that. If you want to make it into a trend program, do it properly. Judy Schofield asked for clarification on this comment, suggesting that a significant trend may not be identified for the data generated under Element 2, but that the design may not provide the statistical power to identify a trend. Mr. Hornshaw agreed.

Louis Blume noted that GLNPO needs to determine the environmental decision they are trying to make for each element. Then design data collection and quality objectives keeping these questions in mind.

Tony Forti stated that he agrees with Tom Hornshaw. He noted that there are lots of issues and waste with start-up programs, such as including a new contaminant like PBDEs. He felt the GLFMP could be of assistance in this area.

Pat McCann agreed that the GLFMP Element 2 data are useful for emerging contaminants that the States are not yet measuring.

Tom Hornshaw stated that the GLFMP Element 2 also would be useful if they could sample less or perhaps could monitor other species.

Pat McCann stated that the GLFMP is useful for screening for emerging contaminants and is useful for trends for legacy and emerging contaminants.

Ron Hites cautioned against reducing frequency, as you also reduce the statistical power to identify trends. Bob Day agreed, and noted that the bumps in the data are important to identify.

Judy Beck noted that other monitoring programs may already be addressing emerging contaminants.

Todd Nettesheim stated that species in other trophic levels, such as crayfish, may be of interest. He noted a multi-agency effort to develop an integrated mercury monitoring strategy and the top priority is looking at crayfish instead of top predator fish. He noted that there are fewer confounding factors with these species, or prey fish, then when looking at top predator species, and suggested that maybe this could fit into this program.

Bob Day stated that they looked at related issues as part of the peer review of their program, specifically using young of the year. He noted that there are lots of disadvantages: the fish are highly variable and contaminant levels can depend on things such as whether there was an early spring or a late spring.

Pete Redmon noted that a 4 to 6 week difference in age can be a huge difference in exposure time.

Chris Schmitt asked what level of analytical precision are you willing to pay for? Are you willing to accept a screening analysis to see if it is safe to eat the fish, or do you want to monitor trends even when fish tissue concentrations may be very low? Expenses at low concentrations go up tremendously. When you go to young of the year, the analytical costs for monitoring purposes rise dramatically. Extrapolating to larger fish can be difficult and costly. Answering these questions will help to determine how to spend your money. If you also want to explain the results, you have to spend additional moneys on data interpretation for different media.

Matt Hudson inquired about the determination of percent moisture in the fish tissue samples. He noted that samples can dry out when they are stored for a long period of time and this can affect final concentration estimates.

Joan Coughlin noted that, as far as she knew, this was not being done.

David DeVault noted that they had not looked at this in the past, but noted that the Canadians have done storage studies as part of their monitoring program.

Matt noted that archived samples could be used to evaluate if changes in percent moisture are an issue. He described a case where they reanalyzed samples in 2003 that had been archived in 1999 for dioxins and furans. They observed a significant loss of moisture that required doing a correction factor on determined concentrations.

Matt raised another point regarding fish age and size. He noted that in reviewing historical monitoring data, it was noted that an average ten year old lake trout was 65 cm in the 1980s, whereas now an average ten year old lake trout is 60 cm. He suggested that collection of age data is important.

Todd Nettesheim noted that he is not suggesting removing lake trout or coho, but was intrigued with the idea of including multiple species.

Louis Blume suggested that the management questions must be clear in order to design the collection and analysis component of the program.

Paul Bertram suggested that, as a scientist, he is interested in trend analysis, but is not sure if that is what they want to do. For SOLEC, they are not trying to look at trends, but looking at metrics in relation to consumption advisory. The question is not so much "is there x ppb in coho Salmon, but what is the meal recommendation?" We need to apply the data generated under the program to a perspective of the changes in the fish consumption advisories. It is important to note that the metric of interest may not be concentration.

Candy Shrank does not agree with that approach. The States have the information to issue fish advisories. Several state and federal participants stated that advisories were not good indicators. Pete Redmon noted that advisories were bad indicators because the States that monitor the most have the most advisories. Pat McCann concurred and cited Minnesota's experience with mercury lakes as an example. Also, participants observed that changes in advisories can be caused by changes in advisory protocols.

Ron Hites asked if the States have enough information to set fish advisories? Do States need Element 2? Everything I heard is "no". Dr. Hites noted that he frankly cannot see what Element 2 provides to States. Perhaps the mechanisms to help set advisories, such as how often they need to sample, but other than that he sees duplication of efforts.

Tom Hornshaw noted that if emerging contaminants is part of Element 2 then that is helpful.

Glenn Warren asked if there is anyway that States could give samples and we analyze. Elizabeth Murphy noted that the program is already doing that.

Joan Coughlin asked if the States have fish tissue contaminant data for the Great Lakes.

Pat McCann stated that they do have data for the Great Lakes, for a number of species, but do not do emerging contaminants.

Glenn Warren noted that they may want to change the objective of Element 2.

Tony Forti stated that there is a lot more knowledge about the toxicity of PBDEs and that they seem to be an important analyte.

David Devault asked if this type of data is useful to states and what should the parameters be? He thinks it is useful to keep doing PCBs and DDTs as indicators of ecosystem trends, but noted that fillets may not be the best way to do that.

Pat McCann stated that the fillet data are for emerging contaminants and it is useful to know exposure.

David Devault noted that it is useful to know something about the ecotoxicological side of the emerging contaminants.

Pete Redmon stated that another issue on emerging contaminants concerns bioaccumulation. Some contaminants may be causing effects, but as short-term exposure. For these cases, tissue analysis is not the way to handle it.

David Devault suggested that the approach to emerging contaminants, when it comes to fish, is to archive samples, find target levels of interest first, and then go back to the archive for analysis.

Ron Hites stated that this is exactly what we did with PBDEs.

Chris Schmitt stated that fillets from tributaries would be the last place to look at emerging contaminants, because of how the samples are prepared and that the fish movement can be dictated by their need to feed on alewives. He mentioned the National Bioaccumulation Study, noting that it was designed to look at the worst case scenario. This study was brain driven. The EMAP program was probability driven. The Bioaccumulation study determined the analytes of interest. Once you have the list of emerging contaminants based on the worst case scenario, go to salmon and determine extent based on the probability scenario.

VII. Question and Answer Session Following Each Presentation on Day 1 of Program Review

A series of presentations were provided on the first day of the review. The following minutes detail the question and answer sessions which followed each presentation provided during the review. See appendix II for list of presentations.

Historical Overview of the GLFMP, David Devault of the United States Fish and Wildlife Service

- Elizabeth Murphy asked if the sampling sites were representative of the entire lakes. David Devault answered that they were only representative of the individual sites. David mentioned that you may be able to construct a longitudinal axis from top and bottom to evaluate the data. Lake Michigan is probably the only lake that you could do this.

- Candy Shrank asked if trends could be based on the coho data. David Devault answered that they could.

- Candy Shrank asked when and why Elements 3 and 4 were abandoned. David Devault answered that Element 3 was dropped in the middle of Reagan's presidency due to budget cuts and that Element 4 was dropped in 1997, but he was not sure why.

- Sandra Hellman asked if the smelt data that had been collected up to the mid 90s had been analyzed**.** David Devault answered that it was available and stored on the ninth floor of the building.

- Ron Hites asked if the last publication containing these data was from 1996. David Devault answered yes and there is plenty of newer data that has not yet been published. Elizabeth Murphy added that these data will be published soon. Russ Kreis mentioned that much of the data were available in graphical form on the GLNPO website, in the State of the Lakes Ecosystem Conference (SOLEC) report and under the binational toxics strategy.

- Tony Forti asked if the water samples were filtered. David Devault answered that they were filtered and the filters were also analyzed. Tony Forti then asked if the program had ever used passive samplers for tracking sources. David Devault answered that they had not, but might next year.

- A participant made the point that congener composition from all lake sites is extremely similar, the only differences lie in the concentrations. She noted that Green Bay is an exception to this and she didn't know how to evaluate the Green Bay data. David mentioned that sampling site does matter and that it is important to sample the fish in the same locations.

- Lou Blume asked if the sites, which were originally chosen because they would not be heavily influenced by near shore influences, were still independent of these influences. David Devault answered that he felt they meet pretty much, but he would have to mine the data to look for that. From what he sees, they do.

- Pete Redmon remarked that one of the things that this program has provided is a long term picture of the environment. The fish are affected by lots of factors, but if you really want to know what is gong on in the environment, this is one of the better pictures.

- Louis Blume asked Russ Kreis if the sites from the Lake Michigan Mass Balance study were representative of the whole lake and not influenced by near shore activities. Russ Kreis answered that he thought so and mentioned the Sheboygan Reef, Sturgeon Bay, and Saugatuck sites. Sheboygan Reef is lowest and Saugatuck is highest and this is what you would expect. They haven't seen large differences in the congener patterns. The data suggest it looks like a historical legacy contaminant that has been mixed up, - except for Green Bay fish. From the river to outside, you can see lower congeners as these are close to sources, but these are lost as bioaccumulation takes over. Based on information we have the Lake Michigan sites are representative of what is happening in lake.

- Deb Swackhamer remarked that she had done water chemistry at three biota boxes and there were no differences among open lake sites, but there were huge differences from year to year based on temperature changes.

- Christopher Schmitt stated that the food web is different as well and that the lake trout are eating different things. He mentioned that it is important to be aware of representativeness of sites from water perspective and a food chain perspective.

- Elizabeth Murphy asked if they had started to age fish. David Devault answered that it had been done in the past.

Historical Record of Target Analytes and Data Management, Sandra Hellman of GLNPO

- Sandra Hellman stated that when they had prepared information for SOLEC and the Binational Toxics Strategy that GLNPO had to use data from David Devault's 1996 paper because the data were not in a database where it was available for use.

- Tony Forti mentioned the success the New York Department of Environmental Conservation had with a Microsoft Access database.

- David Devault warned against using e-mailed data files, likening them to electronic scrap paper. Sandy mentioned that they do have the 1986 to 1989 data that we can put into a database and that the electronic fields have been used to verify numbers in paper. She asked if these data can be used. She mentioned that they can calculate the same means and confidence intervals using the data. David Devault stated that he does not believe it is ok to use.

- Paul Horvatin discussed the Information Quality Guidelines and their impact on usipng historical data.

- Ron Hites asked about the fish archive and stated that USGS may be interested in having someone else take it over.

- Candy Shrank stated that Wisconsin's data are available in a relational database, but in 23 separate files. The database includes data from the same fish from the same sites collected at the same time. She noted that there are some coho data from EPA in the database but she didn't know how it came to the states: maybe in hard-copy.

Overview of Current Program, Deborah Swackhamer of the University of Minnesota

- Deb stated that someone should determine what detection limits are necessary and these should be risk-based. The list of analytes should not be based on whether the lab can detect them or not. David Devault commented that some analytes that were missing from Deb's list were dropped in the mid-1980s and then were returned to the list due to Deb's work. Deb Swackhamer mentioned that dieldrin and endrin were included because of an FDA standard reporting format.

- Judy Beck mentioned that you can compare mercury in lakes to fish consumption advisories. She then asked if you could do that for PCBs. Deb Swackhamer answered that PCB levels in fish were well above the criteria for fish consumption advisories and FDA action level. It was stated that you cannot compare levels in whole fish to fish consumption advisories. David Devault mentioned that if you look at AHH active compounds the concentrations are above the threshold for Lake trout for the ecological impact.

- Christopher Schmitt asked if levels of non-detect compounds were the same among all species. Deb Swackhamer answered that they were. Christopher Schmitt then remarked that it is often a good policy to inform the public of what is not found in the fish.

- Deb Swackhamer commented that the program could adopt a two tiered list of analytes. Some analytes could be looked at every year, while some analytes would only be looked at every few years.

- Christopher Schmitt mentioned that he would be interested in a trend analysis where fish length and lipid content is addressed for coho and chinook salmon. Deb Swackhamer answered that they have done this, but only with fish that were over 550 mm in length.

- Sandra Hellman expressed a concern that documentation was needed that explained clearly why different analytes were added or dropped from the list.

- Ted Smith said that the GCMS scans used to have high detection limits and asked if this was still the case. Deb Swackhamer answered that to address detection limits they used 50 g of fish tissue and did the negative and positive ion scans. She could see PCNs, but didn't see them when using the 2 g of fish tissue that they normally use.

- Ron Hites asked how Deb decided where the breakpoints were. Deb Swackhamer answered that she had done a breakpoint analysis. Ron Hites commented that there had been a change in the program during this time. In 1985 to 1990 there was a change in analysts and this may have affected PCBs in particular and how total PCBs were calculated. Deb Swackhamer confirmed that during this time, they changed the labs that analyzed some compounds. Ron Hites then asked if they should composite fish over many years instead of annually. Deb Swackhamer answered maybe. Bob Day expressed concern that doing this would lose some of the interesting variability.

- Gary Gulezian asked Russ Kreis how his numbers for half-lives coincided with the numbers Deb mentioned. Russ Kreis answered that the numbers have been bouncing around for all lakes. Russ said that all trends are going down including fish, air and water, although they are not statistically significant. This could be caused by food chain differences or by a flood, perhaps as many as 20 variables. His model predicts about an 8 year half life but it depends of the life cycle of the fish you are looking at.

- Pete Redmon commented that he had been studying Lake Michigan for 30 years and has seen 4 or 5 ecosystems since then. He detailed changes in alewife, chinook, and zebra mussel populations over the years. He referred to the lake as a huge uncontrolled experiment.

Overview of the Quality Management Program, Louis Blume of GLNPO

- Korey Groetsch asked if there was a difference between the MDL flag and the UND flag. Lou Blume stated that the data flagged MDL were confirmed, but were below the established method detection limit whereas the UND data were not detected at all. Korey Groetsch then asked if there were quality criteria for the data. Lou Blume answered yes and explained that he wanted QA information to accompany the data so that users would be able to evaluate the quality for their own purposes.

Data Storage and Access, Ken Klewin of GLNPO

- Korey Groetsch asked if GLENDA would replace STORET. Ken Klewin answered that it would not, but it is modeled after it.

- Ron Hites asked if there is anything in this that prohibited or slowed down investigators from publishing. Ken Klewin answered that it does not. They are simply slow at getting the data onto the web. Ron Hites then mentioned in the Lake Michigan Mass Balance study, there was a window of time before the PI could publish the data. Deb and Beth both understood that the data had to be verified first prior to publication, but Lou would have to verify that.

The State of Michigan's Monitoring Program, Bob Day of Michigan Department of Environmental Quality

- A participant asked if one can get a subset of the online database. Bob responded, yes, the database is designed for the average angler in mind.

State and Human Health Concerns, Patricia McCann of Minnesota Department of Health

- Deb Swackhamer brought up that given the recommendation to widen coho and chinook size ranges, the uncertainty is going to be huge and we must find ways to reduce regressions and suggested lipid content. Christopher Schmitt said that some species vary with lipid content, some with length, and some not at all. He said that you almost cannot use GLNPO data for consumption advisories. Robert Day adds that fish lengths drift, some years you get big fish, some years you don't. He noted that based on the peer review workshop, if you can control variability by using the same size fish, you should.

- Pat McCann mentioned that in Minnesota, all fish have mercury, but only those in impaired waters are tested. Korey Groetsch suggested that aging all the fish may sort this out, but this is not important for advisories.

- Ron Hites asked if advisories are based on mercury, PCBs, or the most restrictive of the two. He also noted that some emerging contaminants don't have health data so can't do anything with those data.
  Pat McCann answered that they were based on the most restrictive and could also be based on other analytes.

- Tony Forti stated that you can have fairly poor correlations sometimes, but you even so you can take an average for size classes such as, 30 inches and greater and less than 30 inches. In this case, you typically get a better R-squared.

- Matt Hudson asked how they decided on a 5 year rolling cycle. Pat McCann answered that it was in accordance with the Great Lakes Protocol.

EPA Region 2 Programs, Tony Forti of New York Department of Health

- Robert Day asked if the brown trout data from Lake Ontario were from whole fish or fillets. Tony Forti answered that they were from fillets.

- Christopher Schmitt asked if the fish were caught pre- or post- spawn. Tony Forti answered that he thinks they were caught pre-spawn but would have to check.

- Matt Hudson asked if the anglers in New York were aware of the advisories. Tony Forti answered that the advisories are printed in the fishing regulation guidelines and a survey has shown that 90% of anglers are aware of them. He stated that they had problems reaching unlicensed anglers and many ethnic groups.

EPA's National Lake Fish Tissue Study, Leanne Stahl of United States Environmental Protection Agency

- Ted Smith asked about the amount of fish they were assuming people ate per meal for Minnesota advisories. Pat McCann replied 17 grams a day.

- Pete Redmon and Christopher Schmitt praised Leanne Stahl for running a study on a national level.

- Elizabeth Murphy asked if the study was designed so that the data would be comparable to data collected in the Great Lakes. Paul Horvatin noted that EPA's Office of Water was adamant that the Great Lakes not be included in the study. David Devault remarked that the cumulative plots would be interesting and that it was too bad that the Great Lakes data would not be included.

- Korey Groetsch asked if the project was designed to extrapolate across all lakes. Leanne Stahl answered yes. There were 147,000 lakes in the target population, but by the time they accounted for inaccessible lakes the final pop was about 80,000 lakes.

- Christopher Schmitt noticed that more big lakes were factored in than small lakes. He asked if the data had been weighted. Leanne Stahl answered that they had.

- Ron Hites asked if these data will be released as a government report. He then inquired if there was time and money available to offshoot portions as peer reviewed publications. Leanne Stahl answered that they have discussed it and would like to put the data online.

    - Christopher Schmitt explained that as a government scientist, he has a responsibility to produce government reports. It is difficult to budget both man hours and money to have papers produced for peer review journals in addition to the final reports**.** He continued that even if these funds are obtained, they are the first to be cut when government budgets get tight. He said that he has an obligation to make data available to the public as soon as

it clears QA and is required to make reports widely available. Once this is done, it is difficult to have any of the data accepted by peer reviewed journals because they see it as double publishing.

- Leanne Stahl added that project statisticians for the National Lake Fish Tissue Study preferred to delay release of the data until EPA could compile and analyze the full four years of data; however, EPA management made a policy decision oto allow interim releases of the data.

- Pete Redmon shared a story of a project he worked on where out of 500 sampling events; only 110 were included in a report. He relayed his frustration that all these resources had been used to collect data that were not used.

VIII. Panel Member Comments and Recommendations

Each panel review member was asked to submit additional recommendations or advice to GLNPO for the GLFMP.

A. Robert Day, Michigan Department of Environmental Quality

Thank you for the invitation to participate in the Great Lakes Fish Monitoring Program (GLFMP) review. I have three general comments that I would like to offer to the Great Lakes National Program Office (GLNPO). Also, I have commented on each of the ten recommendations that were developed during the peer review meeting and subsequently, edited and ranked.

My general comments are as follows:

1. **The GLNPO should place the highest priority on releasing all data collected prior to 2004 to partners and stakeholders and develop a streamlined process for releasing data collected in 2004 and later.**

   Ideally, data collected as part of the GLFMP should be released within one year of collection. Program review participants heard that data release was hampered by a number of artificial constraints including the following:

   a. **Application of a Quality Assurance/Quality Control (QA/QC) process originally designed to meet the needs of the Lake Michigan Mass Balance (LMMB) Project.** While this QA/QC process may have been necessary to ensure that all of the components of the LMMB fit together in a way that allowed GLNPO's mass balance model data quality objectives to be met, the process seems unnecessarily complex and burdensome for the GLFMP. The GLNPO should develop a streamlined QA/QC process for the GLFMP. Perhaps the Environmental Protection Agency's (EPA) National Lake Fish Tissue Study QA/QC process could be evaluated since they are able to analyze, review, store electronically, and release more data in a shorter time frame.

   b. **The perception that data cannot be released until they are loaded into the Great Lakes Environmental Database (GLENDA).** GLENDA was developed to provide data entry, storage, access, and analysis capabilities to meet the needs of mass balance modelers and other potential users of Great Lakes data. While the complexity of the GLENDA design may have been necessary to meet LMMB data quality objectives it

seems unnecessarily complex for the GLFMP. The GLNPO should explore the use of other existing data bases for GLFMP data or evaluate options for releasing preliminary data before they are available via GLENDA. The states traditionally received hard copies of GLFMP chinook and coho salmon data directly from the Food and Drug Administration laboratory in Minnesota. Michigan (and other states) entered these data directly into electronic data bases. While electronic transfers of data are preferable to hard copies, hard copies are preferable to no data.

c. **Lack of staff and managerial support for efforts to find and disseminate data that are currently available.** Review participants heard that some data are available in hard copy and that these data have not been made available to stakeholders because they are either not available electronically or staff are unable to locate supporting QA/QC data. Both of these problems seem relatively easy to resolve with the acquisition of data coding staff as well as staff dedicated to the task of searching files and contacting old laboratories. If supporting QA/QC data are not located, then partners (e.g., states that helped with collection) should be given the opportunity to receive the data with the caveat that not all of the supporting QA/QC data can be located.

Finally, data release to partners should not be delayed until after data are published or presented at professional meetings. This is particularly true for the salmon fillet data. Human health objectives are not met when data release is delayed. Also, the salmon samples were collected by GLFMP partners (the states) and partners should not have to wait to see results until after the data are publicly available.

2. The GLNPO should review the original questions that were to be answered by Elements 1 and 2, gather and evaluate all of the data collected to date, review the existing design, and review the underlying assumptions used to develop the current design of Elements 1 and 2.

The GLNPO's whole fish trend monitoring program is one of the premier Great Lakes trend data sets primarily because it was initially well designed and has been implemented for so long. However, conditions in the Great Lakes have changed and fish contaminant monitoring experts have learned more about the behavior of bioaccumulative pollutants in the system. Therefore, while every aspect of the program design and underlying assumptions should be reviewed and questioned; any changes should be made in a way that allow compatibility between new data and old data.

Element I: Open Lake Trend Monitoring

The original intent of the open-lake trend monitoring element was to use changes in whole fish contaminant concentrations as an indicator of ecosystem trends and to evaluate the impacts of certain contaminants on fish health and fish population health. While both of these goals are valid, the primary objective should continue to be trend detection. Environmental agencies are constantly asked to assess ecosystem health and assess the effects of programs designed to protect the environment. Changes in fish contaminant levels are an excellent indicator of ecosystem health (when used in context with other indicators) because fish contaminant trends are relatively easy to communicate and relatively easy for the general public to understand. While some effort has been made to assess the impacts of contaminants on lake trout reproduction, I am not aware that the GLFMP data have been used extensively to assess ecological risk. The trend detection goal should drive future changes to the design of the open lake trend monitoring program (if any) as opposed to the GLNPO's interest in assessing ecological risk.

Program review participants heard that the current design was based on the desire to detect annual changes in total polychlorinated bipheyl (PCB) and total dichlorodiphenyltrichloroethane (DDT) concentrations of 20 percent (%) with 95% confidence. However, available recent data suggest that year-to-year changes greater than 20% (perhaps caused by food chain fluctuations) are not uncommon. Future data quality objectives should be based on an interest in detecting trends over a set period of time (e.g., power to detect a trend of +/- 5% per year of total PCB or total DDT concentrations over the next 10 years).

The GLNPO should reconsider the use of composite samples to control within year variability. It is likely that much of the within year variability could be explained by differences in ages, lipid concentrations, size (length or weight), or gender and data exist to test this hypothesis empirically. While composite samples can reduce contaminant concentration variability, they also reduce ones ability to explain differences between concentrations in composite samples. Collecting a large range of ages and sizes as well as both genders will allow trends analysts to use *post hoc* statistical analyses to account for these differences. In addition, there are economic considerations. The GLNPO could save collection, shipping, and processing costs by working with smaller sample sizes and resource managers will be less willing to provide large samples of economically valuable game fish knowing that alternatives to large sample sizes are available. However, the GLNPO should not change from composite samples to individual samples prior to reviewing models that can accommodate both composite and individual sample types.

It was suggested during the program review that whole smelt or some other type of forage fish were once monitored either as part of Element I or some other part of the GLFMP. The GLNPO should consider adding this component back to the program. Multiple species analyses will help GLNPO trends analysts assess changes that may be due to food chain impacts. Many fish contaminant trends analysts believe that food chain changes are the largest uncontrolled source of variance to Great Lakes fish contaminant monitoring programs. Documenting trends in a forage fish species would help GLNPO provide a more complete assessment of ecosystem trends.

Element II: Game Fish Fillet Monitoring

The program review participants heard mixed messages regarding the original intent of the game fish fillet monitoring element. All agreed that the original intent was to evaluate human health risk and provide data necessary to develop sport fish consumption advisories. However, some noted that the program was never designed to assess temporal trends while others felt that trends detection was part of the original intent of the program. Regardless of the original intent, GLNPO staff and others have published contaminant trends analyses papers using salmon data collected by the GLFMP.

The GLNPO should obtain and review all of the GLFMP salmon data collected prior to 2004 and determine whether or not these data could be used to detect trends. The GLNPO should look for relationships between size (length or weight), location, gender, or lipids and contaminant concentrations. Models used (and published) by others to assess trends in salmon collected as part of the GLFMP should be evaluated along with other published fish contaminant trend models. The GLNPO should develop data quality objectives for trends and determine whether or not these objectives could be met in some or all of the Great Lakes. If not, the GLNPO should determine the number of samples or extent of design modifications necessary to meet trend objectives. These modification options (if any) should be peer

reviewed prior to making decisions about the utility of this element to detect trends. Again, there are benefits to the GLFMP associated with multi-species trends analyses and if trends can be assessed with existing data or obtained for relatively minor incremental costs then these options should be seriously considered.

As noted above, the GLNPO should reconsider the use of composite samples to control within year variability.

3. **The GLNPO should add a new goal or element (Element III?) to the GLFMP that will seek to develop an approach for documenting the occurrence of new and previously unrecognized contaminants in Great Lakes fish.**
Detection of emerging pollutants in the Great Lakes ecosystem should continue to be a priority for the federal, state, and tribal governments in the Great Lakes Watershed. The GLNPO should continue to use the GLFMP to search for those emerging pollutants that will accumulate in fish tissue.

   The GLNPO should not allow the development of new analytical methods to delay the release of GLFMP data. The GLNPO should consider separate contracts with chemists (or separate agreements with existing contractors) interested in analyzing emerging contaminants or developing analytical methodology for potential pollutants of concern. Also, the GLNPO should consider making excess fish tissue samples available to any reputable chemists interested in looking for emerging pollutants or developing new analytical methodologies.

   Emerging chemical analytical results should be used to evaluate the need for changes to the GLFMP analyte list. That assessment should include an evaluation of the potential risk posed by the contaminant.

   Finally, emerging chemical data collected from multiple labs should not be used for trends analyses.

My comments on the edited, ranked recommendations from the peer review meeting are as follows:

1. **Publish and release 1993-2003 data.**

   As noted above, the GLNPO should place the highest priority on releasing new data to stakeholders and streamlining the analytical, QA/QC, and data storage procedures. Again, I feel strongly that data release to partners should not be delayed until after the data are published.

2. **Establish the status and ensure the maintenance of the GLFMP historical sample archive.**

   If a GLFMP steering committee is established then perhaps they could have some oversight or input into the use of archived material.

3. **Establish a GLFMP steering committee to include:**

   a. GLFMP program officer
   b. GLMFP principal investigator
   c. GLNPO – MIRB branch chief

d. State representation
e. Tribal representation
f. Scientific expertise

I believe that "scientific expertise" will be provided by the state and tribal representatives as well as the GLNPO staff. Who does the EPA intend to include by adding this category? If nongovernmental, university, and/or fish contaminant monitoring experts outside of GLNPO, states, and tribes will be sought then perhaps the category should be more specific.

4. Review and revise the analyte list, with particular emphasis on:

a. Selection criteria for analytes
b. Establishment of minimum detection limits
c. Determination of how to best to handle nondetected contaminants, particularly in regards to QA/QC
d. Emerging contaminants (e.g., Polybrominated diphenyl either)

The GLNPO (with assistance from the GLFMP steering committee) should develop a protocol to guide routine review of the analyte list and detection levels. The protocol should include procedures for adding emerging contaminants (including the identification of breakdown products, assessment of potential risk, and determination of minimum detection limits) and removing contaminants from the list. While a steering committee (and other experts) can provide advice and recommendations, the GLNPO should lead efforts to review literature and gather information about potential sources, environmental fate and transport, breakdown products, persistence, bioaccumulation and toxicity for every contaminant on the list. This information should be updated routinely and shared with the steering committee prior to requests for recommendations for changes to the list.

As noted above, the QA/QC process designed to meet the needs of the LMMB seems too onerous for the GLFMP analytes, particularly analytes that are routinely below levels of detection.

5. Develop a procedure or protocol to move an emerging contaminant to the routine analyte list.

The procedure developed to move an emerging contaminant to the routine analyte list should be included in the protocol mentioned above (Recommendation 4).

6. Establish a mechanism to enhance consistency of analytical labs.

Achieving consistent results is a critical component of efforts to track relatively small temporal changes over time. The GLNPO should maintain and use check samples (see below) and minimize the use of multiple laboratories to generate data for use in temporal trends analyses. Even with regional check samples and excellent cooperation among laboratories in the basin, it would be difficult to account for small variations between laboratories. Therefore, the GLNPO must look for opportunities to develop long-term partnerships or long-term contracts with analytical laboratories. The current process of developing invitations to bid every five years will undermine the GLFMP's ability to detect relatively small temporal trends over long periods of time.

7. Include and maintain routine check samples into the GLFMP.

Check samples will allow the GLFMP to assess changes over time that may be caused by improved analytical methods or multiple laboratories. In addition, the GLFMP should plan to maintain a check sample that is large enough to allow other fish contaminant monitoring programs to use the check samples routinely. Widespread use of the check sample will allow investigators to assess their confidence in GLFMP data as well as data from laboratories that are frequently used to support federal and state programs such as the Lakewide Management Plans, Remedial Action Plans, and Superfund.

8. **Better define the goals and stakeholders of both Element 1 and Element 2 of the GLMFP.**

   The steering committee should be asked to assist with this process. Also, this process should be ranked higher than eight of ten. Certainly it should be ranked higher than reviewing the analyte list and developing required detection levels since it will be difficult to complete these tasks without a clear understanding of the goals and stakeholders.

9. **Create an Element 3 of the GLFMP that will seek to develop an approach for documenting the occurrence of new and previously unrecognized contaminants in Great Lakes fish.**

   As noted above, documenting the presence (or absence) of emerging pollutants should be a priority for the GLFMP.

10. **Conduct statistical power analysis on both Element 1 and Element 2 of the GLFMP in order revise and/or develop Data Quality Objectives. Question to be answered by power analysis should include;**

    e. **What is the current power of Element 1? (i.e., what differences can be detected using the current protocol, and how is this likely to change if concentrations decline in the future?)**
    f. **Can Element 2 be used as a trend program? (i.e., what differences can be detected by Element 2 in its present configuration?)**
    g. **What percent change should Element 1 determine to continue the current trend?**
    h. **Can the power of either or both elements be increased by incorporating additional data and information pertaining to the samples, such as fish age, size (length weight or both), gender, lipid content, and moisture content?**

    This recommendation should be ranked second rather than last. Review of the existing data and lessons learned should have a relatively large impact on the outcome of many of the recommendations ranked as higher priorities.

B. Patricia McCann, Minnesota Department of Public Health

GLFMP Review Comments

Pat McCann
MN Department of Health
February 24, 2005

The Great Lakes Fish Monitoring Program (GLFMP) is a valuable resource to the states. In general Great Lakes States have enough data on routine chemicals to issue fish consumption advice. Human health priorities for use of GLFMP data are:

1) Timely evaluation and reporting of data to states, tribes and other users of the data.
2) Screening for contaminants of emerging human health concern – states present at program review all indicated they don't routinely analyze for these and rely on GLFMP to do this testing.
3) Tracking and evaluation of trends in current/historical contaminants as well as emerging contaminants – knowing trends help states determine sampling design i.e. which chemicals to analyze for, how often and the number of fish.

Analysis and evaluation of data from the current program design needs to be accomplished before recommendations can be made on design changes such as species to collect, numbers of samples needed, location number of collection sites and composite versus individual fish samples. Attendees at the program review made a number of valuable suggestions for data analysis. The goals of the program also need to be better defined.

A recommendation was made at the Program Review to form a steering committee. The following are recommendations for program logistics that could be adopted by this committee:

- Establish regular interaction with state/tribal fisheries resource managers for input on species to sample, number of fish collected and collection sites.
- GLNPO should coordinate stock and analysis of check samples for analysis by states, tribes and GLNPO contractor.
- GLNPO should establish a process by which contaminants are added or removed from the analyte list. Classification of chemicals into various groupings may be useful. Considerations for groupings could include frequency of inclusion in testing (rotation schedule), consideration of monitoring versus methods development and levels of concern versus detection levels.
- GLNPO should ensure fish tissue archive retention.

At the end of the review meeting the review panel members made a list of ten recommendations. I concur with those recommendations.

C. Ronald Hites, Indiana University

Comments on the Great Lakes Fish Monitoring Program (GLFMP) Based on the review at GLNPO on February 7 & 8, 2005

The GLFMP has been in existence since about 1970, and it has two main goals: (a) to measure the concentrations of PCB and several pesticides in lake trout and walleye (from Lake Erie only) collected from each of the Great Lakes every one or two years as a way of tracking the trends in contaminate levels in high trophic level fishes from the Lakes and (b) to measure the concentrations of these compounds in sports fishes (primarily Coho salmon) from the Lakes as a way of setting human consumption advisories.

The fishes collected for the first part of this study are ground together, aliquots are frozen, and the samples are kept in a more or less permanent archive in a freezer in Ann Arbor, Michigan, under the auspices of the US Geological Survey. This archive is an important resource for the study of the Great Lakes, and precautions must be taken to make sure this sample archive is properly preserved. This point cannot be over emphasized.

The second goal of this project seems to be leading to problems. Apparently, the eight Great Lakes states each set their own fish consumption advisories based on their own fish sampling and analysis programs. Thus, it is not at all clear how the results of the GLFMP influence the advisories of the various states, each of which seems to have it own agenda. In my opinion, the second goal of the GLFMP dealing with sports fishes could be deleted at little cost to the Great Lakes states but with some cost savings to the US EPA. There is no need to duplicate what the states already seem to be doing for themselves. The only exception might be some guidance from the GLFMP on the selection of emerging contaminants, such as the polybrominated diphenyl ethers. The Great Lakes states need some impetus from the EPA to add new compounds to their analyte list, but in my opinion, this does not require much analytical work -- it simply requires informing the states when a new compound or group of compounds should be added to the analyte list.

Like many programs operated by GLNPO, the QA/QC activities in the GLFMP seem to have taken on a life of their own and seem to have prevented the timely release of data. In fact, no data from this program have been published since the 1996 paper by DeVault et al., which included data for fishes from the lakes through 1992. For this program to be 13 years behind in the release and publication of its data is a shame, and part of the blame rests on the excessive QA/QC requirements. QA/QC should never be an end in and of itself, and in this case, the QA/QC requirements should be simplified so that the data can be released and published in a timely fashion. Data entry should not be a bottleneck either. There seems to be a particularly tricky problem with the measurement and QA/QC of compounds that are no longer present at detectable levels in fishes from the Lakes. These compounds still require QA/QC efforts despite their obvious lack of importance to the actual measurements. Simple procedures should be in place such that it is easy to add or deleted compounds from the analyte list.

The timely release and publication of the data from this program is important. For example, it has been suggested that there may be a “new equilibrium” of contaminant concentrations in lake trout from the Lakes. Given the lack of publishable data from this program since 1992, it is impossible to properly answer this important question. The data from 1992 to date MUST be released and published within the next few months. Otherwise, this program will be another of GLNPO’s well-kept secrets. The dam that holds back the release and publication of these data must be breached. This is, after all, a scientific project, and that implies that the data will be

released and published in a timely fashion so that other scientists can peer-review it and eventually use it. Publication in the peer-reviewed literature is the best way to archive the data and to make it available to a wide audience, but some attention should be given to making the data available in a searchable data-base maintained by GLNPO. In this data base, the data should be unified across all years so that the user would not have to use different search strategies depending on the year of data acquisition.

It may be time to increase the sample sizes used for the trend monitoring program. Given the continuing diminution of contaminant concentrations in these fish samples, one easy way to increase the analytical sensitivity would be to increase the sample size. Going from a sample of two grams to one of five grams improves the sensitivity by a factor of 2.5 with little cost or effort.

Finally, it seems to me that it would have been useful to have some real fisheries people at this review. The selection of the species to be analyzed, the timing of the sample collection, and the sizes and ages of the fish to be included in the sample are issues that may not have been discussed enough at this particular review. Additional issues such as the correct number of sampling sites per Lake and the timing of collection (once or twice per year or every other year) are all ones that a fisheries biologist could help address.

Finally this project needs to have a bit more institutional infrastructure. I suggest that a Steering Committee be created to monitor this project and make sure that the goals are achieved in a timely fashion. This committee could consist of (at least) the project's PI, the EPA's project monitor, a couple of stakeholders from the states, and perhaps some outside academic person who could speak for the ultimate users of the data.

D. Christopher Schmitt, USGS – Columbia

Participation and Overview

I participated as a panel member in the recent review of the U.S. Environmental Protection Agency (EPA) Great Lakes National Program Office (GLNPO) Great Lakes Fish Monitoring Program (GLFMP), which was held Feb. 7-8, 2005 in Chicago, IL. I was invited by GLNPO to critique various aspects of the program, which has been underway since 1970. In addition to attending and participating in the meeting, I reviewed the briefing materials provided by EPA.

The GLFMP analyzes and reports on the concentrations of organic chemical residues and mercury in lake trout and several game fishes (walleye in L. Erie, introduced Pacific salmonids elsewhere) collected regularly from the open waters of the Great Lakes. The lake trout, which represent the top predator fish in the Great Lakes ecosystem, are analyzed as composite samples of whole fish. These samples are intended to reflect ecosystem condition and to detect temporal trends. Fish size is controlled through the collection protocol and the fish are aged; however, although gender is recorded, the composite samples are not separated or controlled for gender. Lipid and moisture content are determined, however. The game fish [walleye; coho and Chinook salmon; rainbow (steelhead) trout] are analyzed as composite samples of skin-on fillets. Data from the latter are used primarily for evaluation of potential effects on the health of sport fishers and to generate consumption advisories as appropriate. However, trend analyses have also been performed on these data in the past. Like the lake trout, the fish used in this component are controlled for size and are aged; lipid and moisture content are measured; and gender is determined but is not accounted for in the aggregation of the fish into composites or in the interpretation and reporting of the findings.

The current list of organic analytes includes PCB congeners (including the AHH-active congeners), a suite of organochlorine pesticides and industrial compounds, and total mercury. Organic analyses are performed by GC-ECD (PCB congeners) and GC-MS/NCI (non-*ortho* PCB congeners, organochlorine residues including pesticides, chlorinated dioxins and furans, PBDEs, and PBB 153). Mercury is analyzed by AA. Most analytes are detected regularly in at least a few samples; however, it was reported at the meeting that *o,p'*-DDT homologs, BHC (HCH) isomers, aldrin, heptachlor, heptachlor epoxide, endrin, and 2,3,7,8-dibenzo-*p*-dioxin (TCDD) were not detected in the most recent (1999-2000) samples. The principal investigator (PI) requested that some of these latter analytes be deleted from the suite of routine analyses on the grounds that the information gained from reporting the non-detects was not worth the cost associated with performing the analyses and the QA associated with them.

The GLFMP would receive little negative feedback if aldrin, heptachlor, and endrin were eliminated; these compounds are rapidly metabolized and are therefore seldom detected in fish. However, and in contrast to what was presented at the review, Tables 6-8 of the December 2004 Project Report indicate that lindane (γ-HCH), endrin, *o,p'*-DDT homologs, and heptachlor epoxide (a and b) were in fact detected in some samples. In addition, Dacthal® concentrations (or lack thereof) were not reported. Table 4 of this report also indicates relatively poor agreement with historic check sample concentrations for several of these compounds; and the PI noted in the report that the relatively small mass of sample extracted may have precipitated the failure to detect TCDD. According to Table 3, the chlorinated dioxin and furans are analyzed by GC-MS/NCI and are reported as homologs; the detection limits are high (10 ng/g) compared with some of the other congener-based analyses. Considering the history of dioxins and furans in the Great Lakes, more sensitive (high-resolution GC-MS?), congener-based analyses capable of detecting relevant concentrations of 2,3,7,8-TCDD and -TCDF seem warranted (see also item 10,

following). Given the foregoing observations, it also seems premature to eliminate any analytes until these inconsistencies are resolved.

In addition to the compounds included in the routine analyses, a limited number of analyses for emerging or previously unrecognized contaminants are performed. These analyses detected relatively few compounds, but some (PBDEs, APEs) were sufficiently widespread for consideration as routine analytes.

It was noted during the review that the lake trout component is unique in its longevity and usefulness, and that it should be continued. This view seemed to be shared by most in attendance. The value of the game fish program was less clear due to many factors, including declining availability of coho, changing fishery management priorities, and slow turnaround of data (see following items).

Additional Observations, Comments and Suggestions

1. A recurring theme in the discussions was the cost in time, effort, and money associated with the seemingly onerous QA and data entry processes that precede the release and publication of the data. It was noted by many that the value of 4-5 year old data for fish consumption advisories is marginal. A possible remedy to consider is the release of "provisional data", along with a suitable disclaimer. USGS has adopted this strategy for real-time water quality (RT-WQ) data from instrumented sites (link to the RT-WQ page for Michigan, with disclaimer: http://mi.waterdata.usgs.gov/nwis/rt). If EPA has no policy specifically prohibiting such interim releases, a similar approach might be considered for GLFMP data (note, however, that USGS is a science / information agency, not regulatory, and may therefore be able to release provisional data). Although it was suggested during the review that "…Data is (are?) like fine wine, improving with age…", this is generally only true after it has been published and withstood the test of time and scientific scrutiny. Unpublished data are more like an automobile or a boat; i.e., they depreciate over time and cost a fortune to own and maintain unless and until they become classics. In addition, most "decision makers" want to know what you have done for them *lately,* not five years ago.

2. The list of current analytes is refreshingly comprehensive; relatively few programs analyze for as exhaustive a list (including toxic PCB congeners) as the GLFMP, and no other program analyzes toxaphene homologs. Given the history and nature of accumulative contaminants in the Great Lakes ecosystem, this is certainly appropriate. Nevertheless, the PI and others have argued in favor of dropping compounds that were not detected in any samples. However, it was also noted that in this era of chemophobia and sensational journalism, it may be good policy to at least occasionally reassure the public of what is *not* in fish from the Great Lakes. The idea of periodically (every 5 y?) analyzing for a complete list is therefore probably appropriate. This might be combined with the "unknowns" part of the program on a rotational basis; i.e., analyze intensively (for unknowns and deleted analytes) on fish from one lake every year, so that it takes five years to complete a cycle. This would make sample flow predictable and facilitate scheduling of laboratory personnel and equipment. It would also make data flow somewhat continuous, an important consideration given that decision makers and the public like to know what you have found *lately*.

3. Although comprehensive, the list of analytes does not include either endosulfan or methoxychlor, the only organochlorine pesticides currently used in the U.S. Methoxychlor is rapidly metabolized and residues are seldom detected in fish. In contrast, endosulfan does

accumulate and is found frequently by those who choose to look for it. However, its analysis is complex in that both the parent compound (endosulfan) and its conjugate (endosulfan sulfate) must be quantified, and these often split into multiple fractions. Consequently, many laboratories do not include it in their "routine" organochlorine pesticide scans. Nevertheless, endosulfan analysis should at least be considered for the GLFMP.

4. Dacthal is the only herbicide on the current analyte list; concentrations were not reported (detected?) in the 1999-2000 samples. Pentachloroanisole, the most stable degradation product of the widely used herbicide 2,4-D and other chlorinated phenols, was historically present in some Great Lakes fish, but at very low concentrations; it is not on the analyte list. Other widely used compounds such as atrazine may also be present. And as noted by the "Emerging Contaminants Workshop", chlorothalonil is also heavily used and may be present in fish. Although these compounds do not bioaccumulate to high concentrations, they have been detected in fish and might therefore be added to the list of "occasionally looked for" compounds.

5. PAHs are widespread pollutants throughout the Great Lakes that are not accounted for in the GLFMP. PAHs represent a paradox, however, in that the most toxic compounds [such as benzo(*a*)pyrene and chrysene] are rapidly metabolized and excreted, and only the relatively benign compounds (such as phenathrene) accumulate (see, for example, Baumann et al. 1987; Braune et al. 1999). In addition, piscivorous fishes such as adult lake trout are at less risk than benthivores, which are exposed through the consumption of sediment-dwelling invertebrates that do not metabolize PAHs and through contact with / ingestion of contaminated sediments (e.g., Maccubbin et al. 1985). There are also many highly toxic substituted PAHs that are difficult to analyze by conventional methods (cf. Fabacher et al. 1988, 1991). Four approaches are commonly used to assess PAH exposure of fish: 1) The carcasses can be analyzed for those compounds that do accumulate; because PAHs occur as complex mixtures it can often be assumed that the presence of the recalcitrant compounds also indicates exposure to the rest, albeit probably not for adult lake trout. Carcass residue concentrations are being analyzed by the EPA National Lake Study (data presented at the meeting); results are pending. 2) Bile can be collected and analyzed either for individual metabolites (with difficulty) or as total PAH-like fluorescence using HPLC-fluorescence (e.g., Maccubbin et al. 1988; Deshpande et al. 2002); this latter approach was employed by the NOAA Status and Trends Program. 3) Hepatic EROD activity (see review by Whyte et al. 2000) can be assayed in the livers of the fish and assessed relative to analytical findings (PCBs, dioxins, etc.), H4IIE bioassay results, or both. This approach has been adopted by the USGS-BEST program (Schmitt 2002). 4) Macromolecular adducts (DNA, RNA, protein, hemoglobin) can be analyzed (see Shugart 2000 and references cited therein). This approach has been used in small-scale studies, but not for monitoring. Of the approaches identified, only No. 1 (carcass residues for recalcitrant compounds) and 3 (EROD) would seem appropriate for adult lake trout; the analyses could be easily incorporated into the GLFMP as presently implemented. Approaches 2 (bile analysis) would be appropriate for other, more benthivorous taxa, and approach 4 (adducts) is logistically and analytically difficult.

6. Mercury (as total mercury) is the only inorganic contaminant included in either the lake trout or the sport fish program. Some may criticize the analysis of total mercury and might prefer instead the more costly analysis of methyl mercury, especially for fish consumption advisories. However, for the purposes of the GLFPM, total mercury is probably sufficient because most of the mercury in fish occurs as methyl mercury, especially in muscle (Bloom 1992, Southworth et al. 1997). Analytically, mercury analysis has taken a quantum leap forward over the last few years. The maturation of combustion AAS as an analytical technology has greatly reduced analytical costs because wet tissues can be analyze directly, without drying or acid digestion. Thus, fish can be analyzed as individuals rather than as composite samples without increasing

total costs, or potentially without sacrificing the fish (Cizdziel et al. 2002, Peterson et al. 2005). Conversely, composite samples can be analyzed less expensively.

7. Arsenic has a long and interesting history in Great Lakes fishes, especially in Lake Michigan, where there was a point-source (see for example Schmitt et al. 1999 and references cited therein). Arsenical pesticides remain in heavy use, and releases from industrial processes are common. Arsenic tends to accumulate in planktivorous fishes and, to a lesser extent, in the piscivores that consume them (Wageman et al. 1978, Hunter et al. 1981). It also accumulates in lipids. Consequently, concentrations in Lake Michigan bloaters were historically greater than those in lake trout. Arsenic occurs primarily as arsenobetaine in fish, a form that is generally perceived as non-toxic (De Gieter et al. 2002). Concentrations may approach levels of concern in dried and smoked fish, however. Considering the concerns expressed about contaminants in species such as lake whitefish and lake herring that are consumed by Native Americans as well as the ongoing debate about arsenic in drinking water, the absence of arsenic from the GLFMP analyte list is somewhat surprising. Even if arsenic in fish is not especially toxic, concentrations may reflect fluxes to the Great Lakes ecosystem; measurement in GLFMP fish should at least be considered, especially if the game fish component is shifted to other taxa (like whitefish).

8. The forward-looking activities of the GLFMP (searches for new and previously unrecognized contaminants) are good to see. These activities presently include a technology-driven component (GC-MS searches of fish tissue extracts) and a more focused approach (more targeted analyses for compounds that may be present based on knowledge of chemical properties, use, and other factors). These approaches are limited by analytical technology and extant knowledge, however. To these might be therefore be added cumulative indicators such as H4IIE bioassay-based screens of extracts or fractions (see review by Whyte et al. 2002) or more recently developed biotechnology-based assays (e.g., Nagy et al. 2002; Richter et al. 1997). These latter methods are not as well validated as the H4IIE bioassay, however. Regardless, comparing the results of such cumulative assays (in this case for dioxin-equivalents) with analytical results (PCB, dioxin, and furan congeners reported as H4IIE TEQs) would indicate the degree to which the chemical analyses have accounted for all the dioxin-like activity in the sample. A wide discrepancy would indicate the presence of chemicals beyond those quantified, and could therefore be used to target specific fractions in certain samples for in-depth analysis. This approach has been used by the USGS-BEST program to screen fish samples for dioxin-like activity (e.g., Schmitt 2002), and similar assays for other classes of compounds are available. At the meeting it was also suggested that the air monitoring data be reviewed for compounds that might accumulate in fish. This seems appropriate, given the history of airborne pollutants (such as toxaphene and PCBs) in the Great Lakes.

9. The concentrations of toxaphene in lake trout seem to be declining throughout most of the Great Lakes, but not in Lake Superior. Toxaphene is analyzed by homolog group, but seems only to be reported as total toxaphene. A related question does not seem to be addressed, however: Has the toxicity of the toxaphene present in the fish also changed? i.e., has the composition of the mixture changed appreciably, or is it only the benign components (which comprise most of the mixture) that are declining in concentration? Historically, there was concern that the relatively few toxic components, which are difficult to separate from the bulk of the mixture, were not declining, and were perhaps selectively accumulated by biota (e.g., Gooch and Matsumura 1987; Bidleman et al. 1993). This would seem to be an important question with respect to the health of the Great Lakes ecosystem.

10. As noted at the meeting, one of the stated premises of the GLFMP is concern for the health of the "fishery" (presumably lake trout, which do not reproduce in some lakes) and the "Great Lakes

ecosystem". It therefore seems remarkable that the potential threat represented by the accumulated contaminants to the fish and to fish-eating wildlife has received such little attention, especially considering that whole lake trout are analyzed in one component of the GLFMP. Threshold concentrations for effects in fish and fish-eating wildlife are known for many of the contaminants present in Great Lakes fish, and evaluation of whole-fish concentrations relative to these thresholds would seem to be an obvious way to gauge the relevance of the accumulated contaminants. This is especially true for dioxin-like contaminants; effects in fish-eating birds, mammals, and the early life stages of fish (via maternal transfer) occur at dietary concentrations <10 pg/g TEQ (Cook et al. 2003; Carvalho and Tillitt 2004; and other studies reviewed by Whyte et al. 2002), and lower wildlife thresholds have been proposed (see summary in Braune et al. 1999). All of these values were exceeded by the PCBs present in 1999-2000 fish from all the lakes (based on the provisional data presented at the meeting)—even without accounting for dioxins and furans. Although the GLFMP is not a wildlife health monitoring activity, it is widely known that Great Lakes fish represent a significant source of contaminant exposure to coastal and inland wildlife, which are also part of the Great Lakes ecosystem. Concentrations of dioxin-like compounds should therefore be evaluated against potential toxicity to fish and piscivorous wildlife.

11. Reference was made in the briefing book to the possibility of incorporating stable isotope analyses (N, C) to account for trophic dynamic changes in the lakes. This approach has been applied with some success in Lake Ontario and elsewhere (Rasmussen et al. 1990; Kiriluk et al. 1995; Cabana et al. 1996; Braune et al. 1999). However, and as noted during the Michigan monitoring program review, the nitrogen isotopic ratio may also be affected by changing nitrogen sources and fluxes (Kendall et al. 1999) and fish age and growth (Overman and Parrish 2001) in addition to trophic structure changes. Therefore, additional measurements (isotopic ratios of FPOM, other ecosystem components) are also helpful. The latter could be readily incorporated into the limnological and plankton monitoring programs.

12. It was noted by some at the meeting that the documentation of biological effects and determination of linkages between effects and exposure are not part of the GLFMP. Nevertheless, if there are no potential effects one might question the need for the program. In fact, the GLFMP and others already monitor "effects" in the form of fish size, age, lipid content, and moisture content. Although these are usually identified as corollary variables that are used to account for otherwise unexplained variation in contaminant concentrations, they are also (or at least could be considered as) indices of fish health and nutritional status.

13. Many of the preceding observations illustrate a general problem with the GLFMP (and many similar programs): The GLFPM has generated far more data than information. Much data remains to be released, interpreted, and reported, and the data are generally under-utilized. The GLFMP represents a tremendous investment and a valuable potential source of information that goes well beyond documentation of temporal contaminant trends, especially if combined with data and information from other sources. During the review we heard many examples of how changing ecosystem structure, fish population dynamics, water temperature, and other factors might have been reflected in changing contaminant concentrations, but little in-depth statistical analysis beyond documentation of trends. Moreover, the tendency to date has been to analyze and report each component independently. Together, the data from the combined GLFMP components and other sources (plankton, limnology, etc.) would be much more powerful and would tell a much more interesting and compelling success story (see, for example, Baumann and Whittle 1988; Tillitt et al. 1998). Although it would be unwise and incorrect to declare total victory, most of the temporal trends are downward, and some compounds are no longer detected.

These findings, which indicate that regulatory and remediation strategies have been largely successful, should be promoted to a greater extent.

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E. Leanne Stahl, USEPA Office of Water

I would like to open my report by saying that I concur with the ten panel recommendations to the Great Lakes National Program Office (GLNPO) listed in a 2/16/05 e-mail message from Elizabeth Murphy and with panel members who stressed the importance of prioritizing the ten recommended actions. In an e-mail message to Elizabeth Murphy on 2/22/05, I suggested some modifications to the proposed priority order of these actions for GLNPO's consideration. The rationale for these modifications was to group related activities.

The additional comments I would like to offer for the Great Lakes Fish Monitoring Program (GLFMP) review are organized below by the topics listed in the technical charge to the program review panel. I have only included the topics where I have the expertise or experience to provide comments.

Sampling Design

A significant amount of the discussion during the second day of the program review focused on the sampling design. Following are some important highlights of that discussion:

- State representatives attending the program review agreed that Element 1 of the fish monitoring program provided valuable trends information and expressed strong support for continuing this component of the monitoring program. One issue raised by some state representatives about the lake trout monitoring was to consider modifying the trend analysis for this program to address changes over a longer time span rather than continuing to analyze changes on an annual basis.

- States raised a number of concerns about Element 2 of the fish monitoring program. Their primary concern was the several-year delay in receiving the results from GLNPO for this component of the monitoring program. They agreed that they did not currently have sufficient data to evaluate the effectiveness of the element and to make recommendations for continuing or modifying it in the future. Following are some other important points related to Element 2 that states noted during this discussion:

  - The target species for Element 2 (Chinook and coho salmon) are declining in numbers and becoming more difficult for the states to collect; other species may need to be targeted if Element 2 monitoring is continued.

  - Data on individual fish rather that composite data would be more useful for state fish advisory programs.

  - Analyzing fillets for emerging contaminants would provide important data for state programs.

- State representatives at the program review stressed the importance of GLNPO maintaining a monitoring program that provides data for multiple fish species.

Sample collection, sample preparation, and analytical methods

- A program review attendee mentioned that sample collection for Element 2 is "somewhat sporadic." A sample collection schedule should be developed for this element that can be consistently maintained by the states, or an alternate means should be identified for sample collection during periods where some states cannot commit the resources necessary to complete sample collection (e.g., a contract or interagency agreement that

can provide sampling support where necessary). This approach made it possible to complete all the scheduled sample collection for the National Lake Fish Tissue Study.

- GLNPO may want to consider having the homogenization laboratory do all the filleting for Element 2. This would increase the consistency in fish handling and sample preparation and reduce the risk of introducing contamination during the filleting process. Making one laboratory responsible for filleting was an important sample preparation requirement in the National Lake Fish Tissue Study. Sampling protocols specified shipping whole fish to the sample preparation laboratory, and all fish in predator composites were filleted in a controlled laboratory environment before homogenization.

- State representatives emphasized that GLNPO can play a critical role in Great Lakes fish monitoring by generating fish tissue data for emerging contaminants. This is an area where the federal program can provide crucial data that state programs can rarely afford. The Office of Water (OW) heard the same message from states across the country during the National Lake Fish Tissue Study. States were eager to obtain dioxin/furan data from the study since analysis costs were usually prohibitively high for state programs. We also received strong support from the states when we added PBDE analysis for one year of fish samples to the study.

Implementation

- The Office of Science and Technology (OST) in OW relied heavily on voluntary participation of states to collect the fish samples for the 4-year sampling phase of the National Lake Fish Tissue Study. State commitments to participate in the study were primarily verbal, although some states did provide written commitments in response to letters requesting their participation. OST offered the following two incentives to maintain state participation for the duration of the study:

  - *Timely delivery of data to states each year of the study*; OST completed tissue analysis, data review, and data reporting to study participants within about a year after closing each field season. Receiving a prompt return on their investment encouraged states to continue their sampling commitment.

  - *Funding to offset travel costs for sample collection*; OST provided funding through small purchase agreements to about half the participating states to cover travel costs they incurred sampling lakes in their jurisdiction. This modest investment ($2500/state/year) made it possible for many states to continue participating in the study.

Data Management

- A strong message from the states is that GLNPO needs to develop a data review and reporting process that expedites distribution of fish tissue data to the states. Two key factors for accomplishing this objective are obtaining all data packages from analysis labs in standard electronic reporting formats and implementing a system for electronic review of the data. The National Lake Fish Tissue Study could serve as a model for developing more efficient data review and reporting procedures.

Programmatic

- As mentioned above, the current GLFMP is not meeting the states' and tribes' need for timely delivery of fish tissue data. GLNPO has already taken steps to address this issue, but may need to consider further actions to increase timeliness for data distribution to the states and tribes.

- Any work that GLNPO accomplishes on emerging contaminants in fish will generate a high degree of interest in other regions of the country, as well as at the national level. I strongly encourage GLNPO to establish and maintain a network of contacts in the Agency's Regional Offices and at EPA HQ to report any new information GLNPO develops on emerging contaminants. The newly formed Emerging Chemicals Workgroup under the leadership of the Office of Pollution Prevention and Toxics could serve as that network.

In closing, I would like to thank GLNPO again for giving me the opportunity to serve on the program review panel and to present information about the National Lake Fish Tissue Study. I enjoyed meeting the program review participants and learning about the Great Lakes Fish Monitoring Program.

F. Tony Forti, New York State Department of Health

Tony Forti Participation in Great Lakes Fish Advisory Program Review

At the request of the U.S. Environmental Protection Agency, on February 7 and 8, 2005 I participated in the Great Lakes Fish Advisory Program Review as a review panel member. In this capacity:

- I prepared and delivered a presentation on the New York State Department of Health fish advisories and the New York State Department of Environmental Conservation fish monitoring program. In this presentation, I discussed agency roles and objectives, analyte and data quality issues, data elements, current and historical data and advisories, and Great Lakes contaminants of concern.

- I participated in discussions of trends in Great Lakes Fish Contaminants, data representativeness and comparison of within lake sites and appropriateness of target analytes and detection limits. I concurred with the general conclusion that the Great Lakes Fish Advisory Program historically has not been a major source of data for fish advisories, and that state programs have been far more important in this area.

- In these discussions, I stressed the importance of using lipid-normalized data for trend analysis. Given time-constraints, we did not have adequate time do discuss this point, and I would recommend that this issue be given consideration in future trend analyses.

- I actively participated in drafting and reviewing panel recommendations. While I agree with all panel recommendations, I particularly recommend that the program emphasize research and monitoring on emerging contaminants in Great Lakes fish, especially PBDEs.

- The proposed formation of a program steering committee is also very important, including Dr. Foran's proposal to include a GLFMP program officer, GLMFP principal investigator, GLNPO – MIRB branch chief, State representation, Tribal representation and scientific expertise.

- I also proposed development of a procedure or protocol to move an emerging contaminant to the routine analyte list, and was pleased to see it included in the draft recommendations.

- Better definition of goals, stakeholders and statistical power analysis for the GLFMP is also an important recommendation.

In summary, my experience on the GLFMP program review committee was a very positive one. I felt that I was given ample opportunity to express my views on how the program is structured and how it performs, and to give suggestions on how it might be improved. I also feel that adoption of the recommendations drafted by the review committee should result in a better, more relevant program which will better serve the Great Lakes states' and tribes' fish monitoring and advisory programs.

IX. Additional Comments and Recommendations

Following the program review, panel members and participants were asked to provide additional comments and recommendations. These comments and recommendations were individually

provided and do not reflect the review panel's recommendations. Individual summations of personal recommendations and participation of review panel members can be found in the appendix.

A. Comments

- A reduction in the frequency or number of locations in the open lake trend monitoring data is not recommended. For example, the hiatus at Saugatuck in the late-1990s has already left a hole in the interpretation of this time period. The current DQO is generally being met for Element I, however, there would be lowa probability of the dataset standing up to rigorous statistical treatment and missing years or reducing years will further compound this problem.

- Element 2, game fish fillet monitoring program, is currently being used as a trend monitoring program, despite the fact that it was not meant to be used for trends.

- Element 1 monitoring program is working and is a good report card. Additional sites on each Lake are desired, but this is cost prohibitive. The DQO of Element 1 is somewhat being met, but after it is subjected to power analysis you will have to double or more, the number of samples and this will be cost prohibitive. These types of statistical analyses generally indicate that more samples have to be collected than can be possibly collected, analyzed, and processed and especially when biological media are involved, the utility of statistical analyses falls apart.

- **Collection of age data:** Collecting age data on the fish is very important for reasons discussed above. However, while it is mentioned in the draft QAPP that age will be collected beginning with 2003 fish, there is no mention of the method for aging the fish or who will do the aging. In general, GLIFWC staff use otoliths to age lake trout because they tend to record cyclic seasonal growth and provide the best age information, particularly for older fish. Otoliths could easily be collected from the fish before they are composited by someone experienced in their removal. You could check with Mike Whittle at DFO in Canada to see how they age their fish. GLIFWC employs technicians experienced in determining age by use of otoliths. GLIFWC staff would be willing to provide some assistance in aging fish from this program if needed.

- **Other fish species to consider for human health component:** GLIFWC-member Tribes in the Lake Superior region typically consume fish species other than salmon (e.g. lake whitefish, lake trout, lake herring). While GLIFWC has and is conducting contaminant studies on these fish species, we have no program in place that tests these fish on a regular basis over time. This information would be useful to tribal members and others because Great Lakes fish such as lake whitefish are popular for consumption by many populations, particularly around Lake Superior. Because the goal of the salmon monitoring is to provide data to monitor potential human health exposure to Great Lakes contaminants and not trend data, we suggest consideration be given to monitor fish species that are most frequently consumed by people around a given lake. In the case of Lake Superior, this may be a species other than salmon. As an example, tribal harvest of lake whitefish from Lake Superior is typically greater than all other species of fish combined. Monitoring a fish species most frequently harvested (and presumably consumed) by people around a given lake could provide the most useful monitoring data regionally. It would also provide a continual source of monitoring data on a locally important fish species when jurisdictions around the lake may not be able to collect these data on a regular basis.

B. Recommendations

- Refine the list of analytes to those that are pertinent to specific lakes, lower the limit of detection on selected contaminants, and conduct scans on about a 3-year basis to examine for emerging contaminants and to confirm that legacy contaminants continue to be non-detects. I felt that Dr. Swackhamer provided good guidance during the meeting on some of these factors.

- The most important value of the data is to determine the trends exhibited. EPA needs to evaluate the trends on a whole lake using the lake trout and the salmon data. EPA should address whether the recent data shows a trend (including significance of length and fat), the power of the current program to detect recent trends and how/if the program should be changed. This should be done for PCBs, chlordane, DDT, and mercury (if they have the data). EPA should address (where they can, e.g. Lake Michigan), if the collection locations are the same or show different trends. The different ways to analyze trends should be evaluated using an approach that can evaluate several different models (e.g. AKAIKE). Element 2 should be continued until the above evaluation is completed. Then we could evaluate if it should be continued depending on the required design.

- EPA should share the data with the states with priority given to PCBs and mercury.

- EPA should report on the new chemicals that they are finding in fish and evaluate the need to continue analysis.

- EPA should not hold up analysis results based on the current status of the database. Articles have been published in this area suggesting that there are people who could run these analyses quickly, ex. Craig Stowe or John Kern. http://www.limnotech.com/pubs/Conf_present/Dekker-IAGLR01-fishPCB.pdf

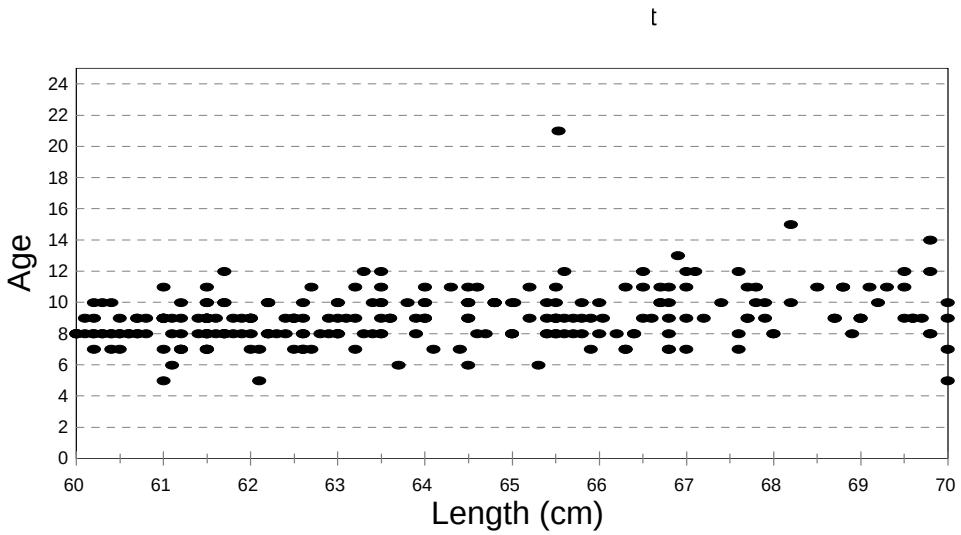
- **Measure percent moisture in fish tissues:** Percent moisture in fish tissue is a parameter that should be measured both at the time of grinding (when tissues most represent conditions from the lakes) and at the time of analysis (to determine the extent to which tissues may have dried out while frozen). It is very inexpensive data to obtain (i.e. weigh a sample of fish tissue before and after drying in an oven) and that could have a large impact on measured wet weight fish tissue concentrations. In the past, percent moisture data have not been collected as part of the GLFMP program.

  As an example of the impact of moisture on tissue concentrations, GLIFWC recently measured (in 2003) dioxin/furan concentrations in archived Lake Superior fish tissues that were collected in 1999. Percent moisture was measured in the tissue composites at the time of grinding and again at the time of the dioxin/furan analysis. The average amount of moisture loss in the edible portion composite tissues was greater than 50%, even though our composites were archived at -20°C in amber jars, with Teflon-lined lids. The moisture loss resulted in significantly higher calculated contaminant concentrations. Because percent moisture was measured in 1999, we were able to back-calculate the concentrations to what they would have been in 1999.

  In summary, the recommendation is to measure percent moisture on all (or a representative percentage of) composites at the time of grinding and before analysis, so wet weight contaminant concentrations can be corrected for any moisture loss during storage. This becomes particularly important when analyzing archived samples.

- **Compositing lake trout by size and age:** In addition to size, age is an important factor to consider when preparing composites of lake trout tissue. At the low concentrations (relative to 1977) that are currently being measured in fish from the program, difference in average age of fish within a composite range could account for much of the variability in contaminant concentrations currently being seen between sample years. For instance, if most of the fish collected in a given year were younger than the majority of fish collected in a subsequent year (within the same size range), the observed contaminant concentrations may be different, but this could be because of age rather than any other factors. Considering age when compositing could control for this factor. Figure 1 is a graph of GLIFWC harvest monitoring data from the area around Keweenaw Point in Lake Superior for lake trout within the GLFMP 600-700 mm size range. The graph shows that there is significant variability in age at any given length.

Figure 1. GLIFWC 60-70 cm lake trout length and age harvest monitoring data (from 1986 to 2003) from five grids around Keweenaw Point in Lake Superior. Each fish aged is included as a point on the graph (259 fish).



- **Revise QAPP in reference to length of lake trout collected:** The draft GLFMP QAPP suggests that the smallest individual in a composite be no less than 75% the length of the largest fish. Therefore, if the longest fish in a composite is 700 mm (the upper end of the current size range), a fish that is 525 mm could theoretically be included in the composite (700*0.75=525). A 525mm fish is outside the current 600-700 mm size range and if fish of such differing lengths (and most likely ages) are included in the same composite, there will undoubtedly be an impact on the observed trend data. Consider revising the 75% number to stay consistent with the size range of lake trout chosen.

- **Properly identify lake trout form:** Along the same lines as the previous comment, in Lake Superior there are several recognized forms of lake trout, most notably the siscowet (*Salvelinus namaycush siscowet)* and the 'lean' lake trout (*Salvelinus namaycush namaycush*). Each has unique biological features such as lipid content, age at size, growth rates, and age of sexual maturity. These differing characteristics will undoubtedly impact interpretation of

trend data if the forms of lake trout are unknowingly combined within the same composites. Scientists on Lake Superior have held training workshops to ensure that field personnel properly identify the various forms of lake trout on Lake Superior. Those who collect fish from Lake Superior for the GLFMP should be properly trained in identification of the forms of lake trout present in the lake.

- **Require a training session for sample collectors:** The proposed QAPP for fish sample collections is certainly needed, particularly with the multiple groups that will now be involved in collecting fish. Proper sample collection is critical to providing the quality of data desired for the program. The QAPP goes into some detail on how experienced people will be chosen for sample collections and that the QAPP must be followed by those people. We suggest requiring a training session (perhaps by conference call) for those involved in sample collections so everyone clearly understands why the instructions in the QAPP are so important to good data quality. This will ensure that everyone understands the "why" behind the detailed instructions and helps to give purpose to following them.

X. Appendices

Appendix I Program Review Agenda

Great Lakes Fish Monitoring Program Review

Sponsored by the U.S. Environmental Protection Agency
77 West Jackson Boulevard, Lake Michigan Room, 12th floor
Chicago, Illinois
February 7th and 8th, 2005

February 7th Part 1: Program Review

11:00	Introductions	Gary Gulezian
11:05	Objectives of program review, review of agenda and technical charge	Paul Horvatin
11:10	Historical Overview of the GLFMP ▸ Objectives and goals ▸ Stakeholders and intended data uses ▸ Determination of target analytes ▸ Determination of collection sites and representativeness of data ▸ List of analytical laboratories supporting the program by year ▸ Question and answer session	David DeVault
12:10	Current Sampling Plan of the GLFMP ▸ Partners ▸ Collection Protocols ▸ Sampling Sites	Beth Murphy
12:20	Historical record of target analytes and data management ▸ Target analytes throughout the program ▸ Status of historical data	Sandra Hellman
12:30	LUNCH	
1:15	Overview of current program ▸ Trends in Great Lakes Fish Contaminants ▸ Data representativeness and comparison of within lake sites ▸ Appropriateness of target analytes and detection limits ▸ Data reporting standard issues ▸ Question and answer session	Deb Swackhamer
2:15	Overview of Quality Management Program ▸ Quality system documentation ▸ Data verification and data quality assessments ▸ Technical assessments	Lou Blume

2:30	Data Storage and Access ▸ Storage of GLFMP data ▸ Access of data by stakeholders ▸ Examples of data outputs o 1992 – 1998 data o 1999 – 2000 data	Ken Klewin
3:00	Break	

February 7th Part 2: Stakeholder Use of GLFMP Data

3:10	The State of Michigan's monitoring program ▸ Goals and objectives ▸ Uses of GLFMP data ▸ Data needs and other issues	Bob Day
3: 30	State and human health concerns ▸ Overview of Minnesota's fish advisory program ▸ Uses of GLFMP data including development of fish advisories ▸ Data needs and other issues	Pat McCann
3:50	EPA Region 2 programs ▸ Overview of New York's fish advisory and monitoring programs ▸ Uses of GLFMP data including development of fish advisories ▸ New York's monitoring program experience	Tony Forti
4:10	EPA's National Fish Study ▸ Goals and objectives ▸ Data storage and access	Leanne Stahl
4:30	Question and answer session for presenters	
4:55	Wrap-up and overview of Day 2	Judy Schofield
5:00	Adjourn	

February 8th Part 1: Discussion of Technical Charge

9:00	Welcome and Day 1 review	Judy Schofield
9:05	Discussion of technical charge questions	All
10:00	Recommendations to Panel by stakeholders and participants	All
11:00	Break	

February 8th Part 2: Panel Discussion and Recommendations

11:15	Question and answer session	

	of stakeholders and participants by panel	All
12:00	LUNCH	
1:00	Panel discussion and development of recommendations	Panel
2:00	Panel delivers recommendations to GLNPO	Panel
3:00	Adjourn	

Appendix II. PowerPoint Presentations

Paul Horvatin	Great Lakes Fish Monitoring Program Review – Objectives and Technical Charge
David DeVault	Great Lakes Fish Monitoring Program – History and Overview
Beth Murphy	Current Sampling for GLFMP
Sandra Hellman	Great Lakes Fish Monitoring Program – Historical Data Overview
Deborah Swackhamer	Great Lakes Fish Monitoring Program
Louis Blume	Overview of the Great Lakes Fish Monitoring Program Quality Management System
Ken Klewin	GLENDA for Fish – Great Lakes Environmental Database System
Bob Day	Michigan's Fish Contaminant Trend Monitoring Program
Pat McCann	Minnesota Fish Consumption Advisory Program
Tony Forti	New York State Fish Monitoring and Fish Advisories - Re: Great Lakes Fish Monitoring Program
Leanne Stahl	EPA's National Lake Fish Tissue Study: A Unique Partnership
Mike Whittle	SIZE Vs AGE Vs Tissue TYPE - DOES IT MAKE A DIFFRENCE

Great Lakes Fish Monitoring Program Review – ***Objectives and Technical Charge***

Paul Horvatin – Great Lakes National Program Office

February 7, 2005

Goals of GLFMP

- Monitor temporal trends in bioaccumulative organic chemicals in the Great Lakes using top predator fish as biomonitors.
- Assess potential human exposure to organic contaminants found in game fish.
- Provide information on new compounds of concern entering the lakes ecosystem.

Objectives of Program Review

- Enhance the quality and validity of the GLFMP.
- Ensure the data generated under the program meet the needs of the stakeholders.
- Ensure any future decisions based on the program have a solid and credible scientific basis.

GLFMP Stakeholders

- Great Lake States and Tribes
  - Fish Consumption advice programs
  - Monitoring programs
- Federal Agencies
- Universities

Technical Charge

- The charge to the program review panel is to objectively review the design, implementation, and scientific rigor of the GLFMP. The panel is asked to comment on the program's sampling and analytical procedures and the uses of the data generated in the program.

Technical Charge - ***specifically consider and address***

- Sampling Design
- Sample collection, sample preparation, and analytical methods
- Data representativeness
- Target analytes
- Implementation
- Quality Assurance
- Data Management
- Programmatic issues

Agenda

- February 7th
  - Discussion Panel 11am – 5pm
  - Dinner at Greek Islands 6:30pm – 8pm
- February 8th
  - Discussion Panel 9am – 11am
  - Review Panel 11:15am – 3pm

Great Lakes Fish Monitoring Program

History and Overview

David DeVault
U.S. Fish and Wildlife Service

History

- 1969 - US FWS began monitoring of DDT and Dieldrin in Lake Michigan bloater chubs
  - Fish as indicator of ecosystem trends
  - Impacts on fish
- 1970- Lake trout and PCBs added
- 1975 – US FWS data presented at National PCB Conference held by EPA

History

- 1977- EPA expanded to include lake trout and smelt from all lakes
  - Covariance design
- 1980-Program re-designed due to failure of covariance design
- Three Element Cooperative program resulted
- Fourth Element added in ~ 1990

Element I – Open Lake Trend Monitoring

- Fish as indicator of ecosystem trends
- Impacts on fish
  - Lake trout (walleye)/smelt 2 sites/lake, 3 on LM
  - 10 five fish composite samples/site
  - Smelt replaced with primary forage ~ 1990
  - US FWS – Collect, prep. QA
  - US EPA – chemical analysis
  - Jointly control release of data, control archive, publish

Element I – Open Lake Trend Monitoring

- QA
  - Detect 20% change between any two samplings at 95% CI
  - Recovery Samples: Lake trout homogenates spiked with known concentrations of PCBs and pesticides
  - Check Samples: Well characterized lake trout homogenates
    - Round robins (US FWS-Ann Arbor, US FWS-Columbia, US FDA-Minneapolis)

Element I – Open Lake Trend Monitoring

- QA run with every 10 environmental samples
  - Recovery samples +/- ?%
  - Check samples +/- 10% of known concentration
  - Expanded to +/- 2 SD in ~ 1990
- New check samples run against old check samples
- Each method change run against check samples
- Labs required to demonstrate ability to meet limits

Element I – Open Lake Trend Monitoring

- Parameter Selection
  - GC/MS scans 1977- 1986
  - US EPA Duluth
  - Nearshore fish and sediments
  - Literature
  - Contacts

Element II – Game Fish Fillet Monitoring

- Evaluate risk to human health
- Secondary indicator of ecosystem trends
  - States- collect, fillet samples
  - US FDA- Chemical analysis, technical assistance
  - US EPA/US FDA jointly publish
  - 1980-1984: 3 five fish coho skin-on fillet composites
  - 1985-?: Coho even years, chinook odd years
  - Additional species as requested

Element II – Game Fish Fillet Monitoring

- QA
  - US FDA Pesticide Analytical Manual
    - litigation quality data
- Labs
  - US FDA-Minneapolis

Element III Nearshore Monitoring

- Identify source areas of known contaminants
- Early detection of "new" contaminants
  - Resident fish and sediments
  - GC-EC for PCBs and other contaminants
  - GC-MS Scans
- EPA- CRL

Element IV – Water Column Monitoring

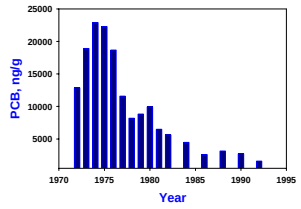
- Indicator of ecosystem trends
- Support IADN
  - 6 sites /lake prior to stratification
  - Particulate and dissolved

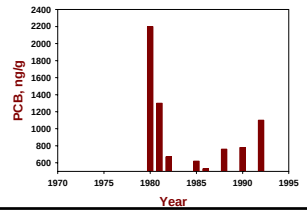
Lessons Learned

- Lake trout/walleye do track system trends scales of a decade, or so
- Year to year variation more strongly influenced by food web and other factors than system trends
- Different trends for different species over similar time periods
- Sampling locations and time are CRITICAL

Lessons Learned

- Need multiple species and additional media to avoid gross errors in interpretation
- Need water data for quantitative lake to lake comparisons
- Useful indicator of fish health
- Objectives and DQA must be clearly thought through
- Rigorous QA (for the things that matter) is Essential
- Coho (LM) are excellent system integrators

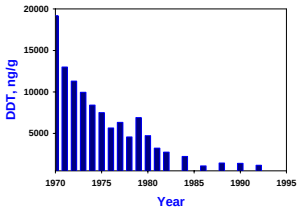


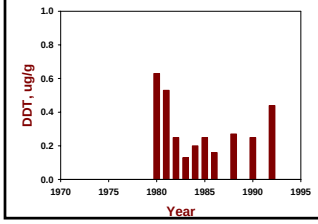


PCBs

Lake Michigan
Lake trout trends

Lake Michigan
Coho trends

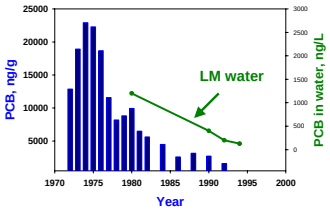


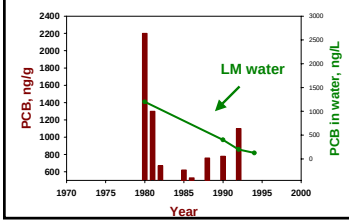


DDT

Lake Michigan
Lake trout trends

Lake Michigan
Coho trends

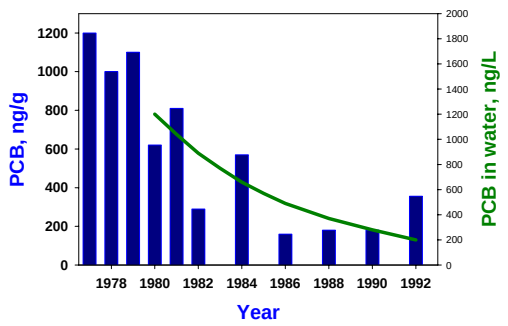


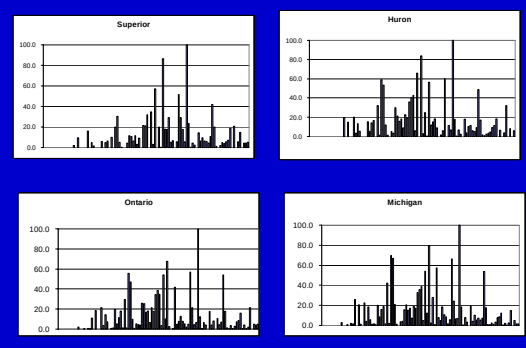


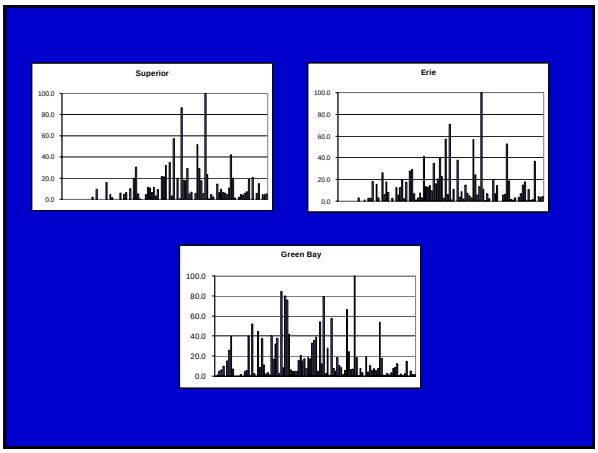
PCBs

Lake Michigan
Lake trout trends

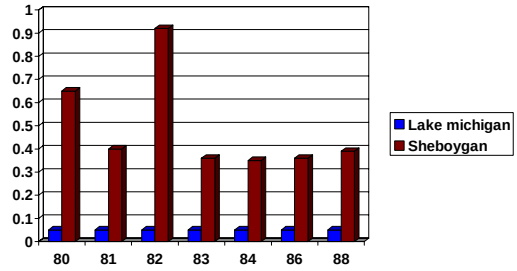
Lake Michigan
Coho trends







Aroclor 1242 in Coho salmon (ug/g)



Important Spin Offs

- US FWS/US FDA assistance to States
- Comparable data across agencies
- Great Lakes Fish Advisory Protocol
- Retrospective analysis of AHH active PCBs
- Retrospective analysis of Toxaphene
- Statistical baseline for PCDDs and PCDFs
- GLNPO water program
- Dated sediment cores
- Extensive studies of bioaccumulation in LS
- Personal connections to larger community

–The More Agencies, The Better!!!

Element I – Open Lake Trend Monitoring

- Laboratories
  - 1969-1976: US FWS-Ann Arbor, packed col GC/EC
  - 1977-1986: Contractors at EPA-CRL, packed col GC/EC
  - 1986-1992: WI Lab of Hygiene, Cap. Col. GC/EC
  - 1993-1997: USGS-Ann Arbor, GC/MS

History

- 1950s - Lake trout expatriated, 90% of biomass alewives
- 1960s – Stocking of lake trout, coho and chinook salmon
- 1960s – DDT, PCBs, dieldrin identified in Great Lakes fish

Current Sampling for GLFMP

Beth Murphy
Program Officer for Great Lakes Fish Monitoring Program
Great Lakes National Program Office
USEPA
February 7, 2005

Partners

- **Previously partnered with**
  - FDA
  - USGS – BRD
- **Currently partnering with**
  - All 8 Great Lakes States

Collection Protocol – **Predator Fish**

- **Lake Trout (Walleye in Lake Erie) are collected in the fall from specified locations.**
- **Fish of similar size are collected to reduce impact of size variation on data.**
- **Whole fish are analyzed, including parts not usually eaten by humans, such as liver and bones.**
- **50 fish - 10 composite samples of five fish**

Collection Protocol – **Game Fish**

- **Coho salmon (even numbered years) and chinook salmon (odd numbered years) are collected in the fall when they return to spawn**
  - ***-Rainbow Trout are collected in Lake Erie***
- **Skin-on fillets**
- **15 fish - Three composite samples of five fish (small, medium, and large)**

Sampling Sites – Predator Fish

Even year
- Lake Superior – Apostle Islands
- Lake Michigan – Saugatuck
- Lake Huron - Rockport
- Lake Erie - Middle Bass Island
- Lake Ontario - Oswego

Odd Year
- Lake Superior - Keewenaw Point
- Lake Michigan - Sturgeon Bay
- Lake Huron - Port Austin
- Lake Erie - Dunkirk
- Lake Ontario - North Hamiln

Sampling Sites – Game Fish

Even Year

Mi	St. Joes R.
	Grand R.
	Platte R.
	Thompson Cr.
	Swan R.
	Ausable R.
In	Trail Cr.
Wi	Root R.
	Kewaunee R.
	Pike Cr.
Mn	French R.
Oh	Grand River
NY	Salmon River
Pa	Trout Run
IL	Chicago H.

Sampling Sites – Game Fish

- **Odd Year**
  - NY Salmon R.
  - Pa Trout Run
  - Mi St. Joes R.
    Grand R.
    Platte R.
    Thompson Cr.
    Swan R.
    Ausable R.
  - In Trail Cr.
  - Wi Root R.
    Kewaunee R.
    Pikes Cr.
  - Mn French R.
    Knife R.
  - Oh. Grand River
  - IL Chicago H.

Sampling sites

GLFMP collection strategy

- **GLNPO identifies collectors and provides funding when necessary**
- **DynCorp provides collection support and sample shipment**
- **Axys Lab, a DynCorp subcontractor, provides homoginization support**
- **University of Minnesota conducts analysis and provides report**

Thanks and questions??

Great Lakes Fish Monitoring Program

Historical Data Overview

1970-1998

GLFMP Partnership

- Mid-1960s, U.S. Fish and Wildlife Service (currently USGS-BRD) begins monitoring lake trout for organic contaminants in the Great Lakes Ecosystem
- Late 1970s, USFWS collaborates with U.S. EPA, GLNPO, to monitor top predator fish in all five Great Lakes - partnership
- 1980, Great Lakes Fish Monitoring Program (GLFMP) expands to include sport fish Coho and Chinook salmon, Great Lakes States and U.S. FDA join partnership
- 1997, USFDA leaves GLFMP Partnership
- 2003, USGS-BRD leaves GLFMP Partnership

Open Lake Trend Monitoring

- USFWS (USGS-BRD) - collects and processes fish, archives fish tissue sample, reporting
- USEPA, GLNPO - responsible for chemical analyses, reporting, coordination

Game Fish Fillet Monitoring

- Great Lakes States - collect and fillet fish, shipping
- USFDA - fish processing and chemical analysis, reporting
- GLNPO - coordination, reporting

Each agency involved in the partnership was responsible for following its own SOPs and/or QAPPs.

GLFMP Databases

- Oracle Database, GLENDA - specifically designed for LMMB, many required fields including QA/QC information
- Access Database - specifically designed for historical fish data that cannot reside in GLENDA, no required fields, recently developed and not ready for public distribution

GLFMP Historical Data - GLENDA

- Open Lake Trend Monitoring Data 1991-1998
- Game Fish Fillet Monitoring Data 1998

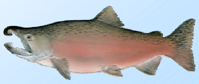
GLFMP Historical Data – Access Database

- Open Lake Trend Monitoring Data 1970-1990
- Game Fish Fillet Monitoring Data 1980-1997

Status of Access Database

- Incomplete, not ready for public distribution
- Following completion, GLNPO and GLFMP partners review database
- Goal - make finished product available to the public - will include disclaimer regarding missing QA/QC data

Great Lakes Fish Monitoring Program



Sponsored by
US EPA GLNPO
Chicago

Deborah L. Swackhamer
University of Minnesota

Management Objectives

- **Monitor time trends in PBT using fish as bioindicators**
  - 600-700 mm lake trout
  - 10 composites of 5 fish each
  - Detect 20% change with 95% confidence
- **Evaluate human consumption exposures**
  - Coho (3 yr old) and chinook (3-5 yr old) salmon
  - 3 composites of 5 skin-on fillets

Analytes

PCBs
Co-planar PCBs
PeCB
HCB
OCS
Hexachloro-cyclohexanes
Toxaphene
Mirex

o,p-DDT, -DDE, -DDD
p,p-DDT, -DDE, -DDD
Heptachlor
Chlordane
Nonachlor
Heptachlor epoxide
Oxychlordane
Aldrin
Dieldrin
Endrin

Analytes

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Heptachlor
Chlordane
Nonachlor
Heptachlor epoxide
Oxychlordane
Aldrin
Dieldrin
Endrin

Emerging Contaminants Workshop

Chicago, March 2001

- Dr. K. Kannan, MSU ➢ PFOS
- Dr. Cliff Rice, USDA ➢ APEs
- Dr. Mehran Alaee, CCIW ➢ BFRs
- Dr. Ron Hites, IU ➢ PBDEs
- Dr. Ed Furlong, USGS ➢ P&PCPs

Emerging and Additional Contaminants

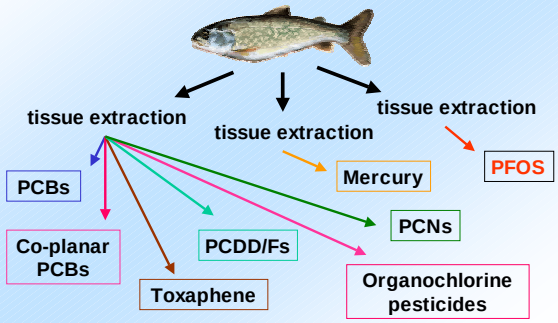
Added in 2000

- PBDEs
- PCNs
- PCDD/Fs
- Hg
- PBB-153

Reconnaissance

- PFOS
- PBBPA
- APEs
- Chlorothalonil
- SCCPs

Methods Overview



Lake Trout Collection Sites

	Even Years	Odd Years	Occasionally
Superior	Apostle Isl	Keweenaw	Whitefish Bay
Huron	Rockport	Port Austin	
Michigan	Saugatuck	Sturgeon Bay*	Charlevoix
Erie	Bass Isl	Dunkirk*	
Ontario	Oswego	N. Hamlin	
	coho	Chinook	

Sport Fish sampling sites

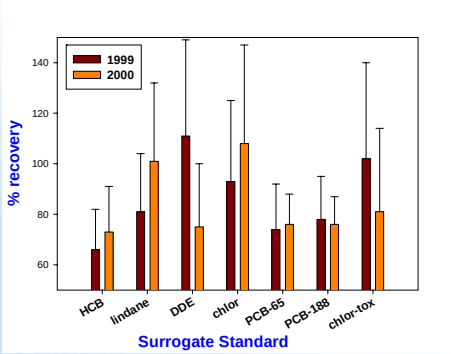
Compounds Regularly Detected

- PCBs
- a-HCH
- HCB
- OCS
- Toxaphene
- p,p-DDE + DDT
- Dieldrin
- Mirex (LO only)
- Oxychlordane
- Cis + trans Chlordane
- Cis + trans Nonachlor
- PBDE congeners
- PBB-153
- Hg

Compounds Not Detected

- PeCB
- Lindane
- Heptachlor
- Aldrin
- Heptachlor epoxide a + b
- o,p-DDT, DDE, DDD
- Endrin

Some QA Results



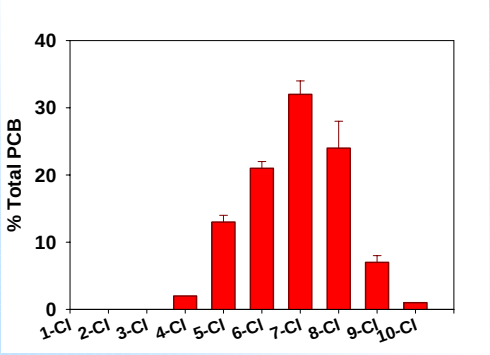
Current Data

- To be presented

Current Trends

- To be presented

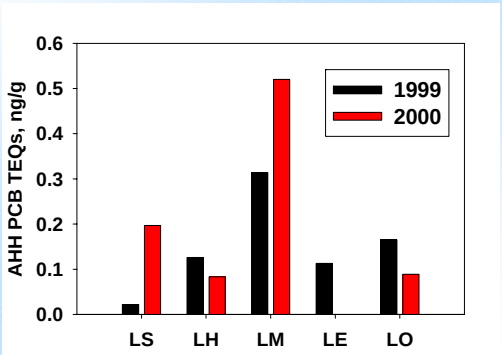
PCB Homolog Composition
All Species, All Lakes



PCB and DDT Current Half-lives

- **Superior, Huron, Michigan**
  - **DDT: no statistical change**
  - **PCBs: no significant change (at least 12-15 yrs)**
- **Erie, Ontario**
  - **DDT: 10-15 yrs**
  - **PCBs: 9-18 yrs**

AHH PCB TEQs, Lake Trout



Summary and Conclusions

- **Legacy chemicals continue to decline or have reached a "steady state"**
  - ***MQOs should be revisited***
- **PBDEs and PFOS detected**
  - ***Continue to consider emerging chemicals***
- **Hg equal to or below inland lake concentrations**
- **QA necessary but costly - Analyte list needs to be revisited**
  - ***Drop nd compounds, or determine required MDL of tox-significant compounds***

Overview of the Great Lakes Fish Monitoring Program Quality Management System

Louis Blume

February 7, 2005

Quality System Documentation

- Quality Management Plan for the Great Lakes National Program Office, EPA 905-R-02-009, Revision 02
  - Approved October 2002

Quality System Documentation

- Quality Assurance Project Plan (QAPP) for Sample Collection Activities
  - Drafted by GLNPO and CSC
  - Describes the quality assurance (QA) and quality control (QC) activities and procedures associated with collecting samples of fish tissue
  - Contains fish collection SOP, fish homogenization SOP, field recording forms and chain-of-custody records, etc.
- Trends in Great Lakes Fish Contaminants Quality Assurance Project Plan
  - Submitted by the Principal Investigator Deb Swackhamer
  - Outlines the quality assurance activities associated with the analytical component of this project
  - Analytical SOPs also are available

Quality System Documentation

- The Great Lakes Fish Monitoring Program Quality Management Plan
  - Under development at GLNPO
  - Outlines overall project objectives and associated project-level quality control activities
- The Great Lakes Fish Monitoring Program Historical Document
  - Under development at GLNPO
  - Provides a history of the project design and implementation prior to 2003

Data Verification

- Data are reviewed for compliance with the GLENDA standard by an independent data reviewer
  - A series of automated checks are conducted to assess completeness and agreement among data submitted from multiple data sources (e.g., do all analytical records have associated field records, do all lab duplicates have associated routine field samples, etc.)
  - These checks also verify merging of routine sample data and quality control sample results to ensure data will be flagged appropriately (see next slide)
  - All data are checked for compliance with GLENDA allowable codes

Data Verification

- Performance-based measurement system
  - Data are flagged according to pre-defined measurement quality objectives (MQOs) outlined in the analytical QAPP
  - Flagging is conducted by PI for some QC samples and by an independent data reviewer for other QC samples
  - As much as possible, flags applied by PI are verified by independent data reviewer
- Summary level data presented in 1999/2000 data report also were verified by independent reviewer using GLENDA database

Data Verification

- Data verification complete for 1999
  - Draft narrative submitted
    - Additional mercury QC information is needed to complete narrative
  - Flagged data set provided to PI for review
- Data verification close to complete for 2000
  - Draft narrative submitted
    - AHH PCB congener data not yet submitted
    - Additional mercury QC information is needed to complete narrative
  - Flagged data set should be submitted in February
- Data verification complete for Lake Michigan Mass Balance Data (i.e., 1994 and 1995)
- Data verification for other years???

Data Quality Assessments

Data quality is assessed quantitatively:

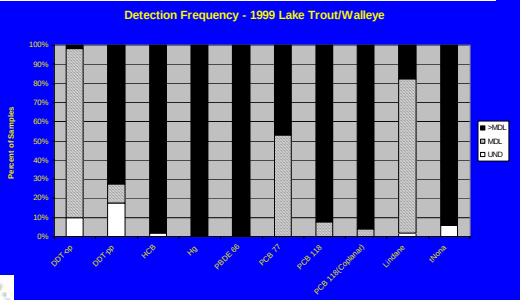
1. Frequency of flags applied to data by analyte
   - Presented in Table 1 of data quality assessment
2. Sensitivity, precision, and bias estimated using results of QC samples
   - Presented in Table 2 of data quality assessment

Data Quality Assessments

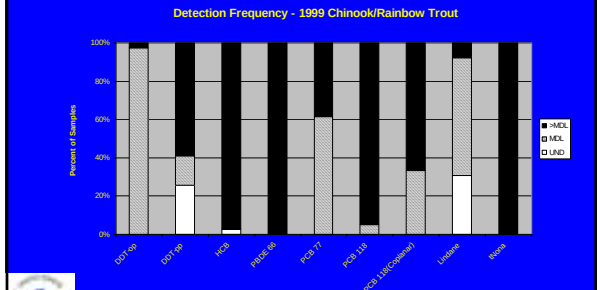
Sensitivity

- The percentage of samples for which the result was flagged as being below the detection limit (MDL) or not detected (UND)
- For 1999:
  - Percentages ranged between 0% and 100% for all analytes and for each analyte group
  - Median percentages of results below the detection limit were 8% for pesticides, 4% for PCB congeners, and 51% for "toxic" PCB congeners (causing response in AHH receptor), and was 7% over all analytes. For mercury, all results exceeded the MDL

Sensitivity



Sensitivity

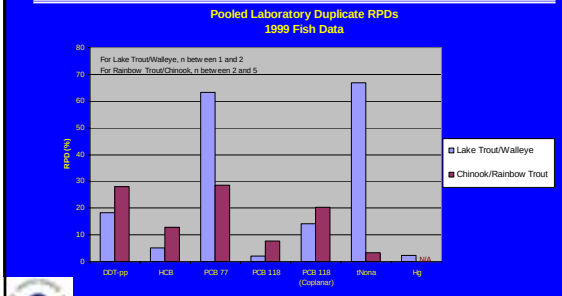


Data Quality Assessments

Precision

- Assessed by calculating pooled RPDs between results for field samples and laboratory duplicates
  - Square root of the mean of the squared RPDs
- For 1999:
  - The median pooled RPD was 21% over all analytes, and ranged between 2% to 169%
  - For pesticides, the pooled RPDs ranged between 7.0% and 105.2%, with a median of 37.0%
  - For PCB congeners, the pooled RPDs ranged between 5.3% and 105%, with a median of 16.6%
  - For "toxic" PCB congeners, RPDs ranged between 5.6% and 121.7%, with a median of 23.6%
  - The pooled RPD for mercury was 2.3%
  - RPDs tended to be higher for results close to or below the MDL

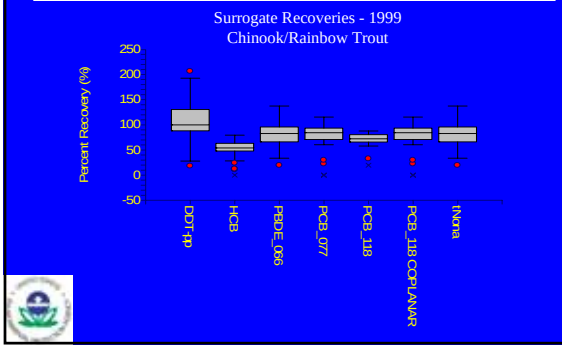
Precision



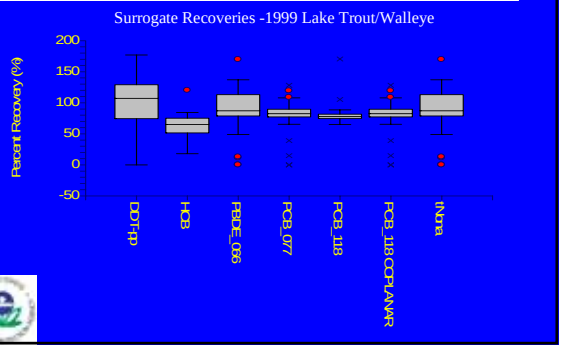
Data Quality Assessments

- Bias
  - Analytical bias determined based on the percent recoveries of the seven different surrogates
  - For 1999:
    - Mean surrogate recoveries ranged between 59% (for 13C-HCB) to 104% (for 13C-DDE-pp)
    - Median surrogate recoveries ranged between 62% (for 13C-HCB) to 105% (for 13C-DDE-pp). For 13C-lindane, the distribution of surrogate recoveries was heavily skewed due to a single surrogate recovery of 1,727%. Therefore, the mean recovery (97%) and median recovery (76%) differed greatly

Bias



Bias



Data Quality Assessments

- Completeness
  - Assessed based on the percentage of sample analyses that were not marked as invalid, rejected or cancelled (among other measures)
  - For 1999:
    - Overall, only 4.7% of analyses were flagged as being invalid, rejected or cancelled. This percentage ranged between 0 to 91% per analyte.
    - The percentage of analyses that were flagged as invalid, rejected or cancelled was below 10% for all analytes except PBDEs.

Data Quality Assessments

- Well-characterized Reference Samples
  - In the 1980s, a large composite of lake trout from Sturgeon Bay, Lake Michigan was prepared by Dr. Robert Hesselberg of the USFWS (now known as the USGS-BRD)
  - Sample aliquots were to serve as reference samples to track reproducibility and comparability within a lab and between labs
  - Sample aliquots were depleted in mid-1990s and a new sample was prepared by USGS-BRD
  - GLNPO does not have data that compares the new reference sample with the old reference sample

Data Quality Assessments

- Well-characterized Reference Samples
  - Analytical laboratory (UMN) compared analytical results for the new reference sample against results obtained by USGS-BRD
  - Overall reproducibility within the analytical laboratory was 13%+/-11%
  - Overall reproducibility within BRD was 28%+/-11%
  - The mean RPD between the two labs was 33%+/-33%

Technical Assessments

- Technical assessments have been conducted for:
  - The analytical laboratory, of Dr. Deborah Swackhamer, at the University of Minnesota, School of Public Health, Department of Environmental and Occupational Health
  - The sample preparation laboratory, Axys Analytical Laboratories in Sydney, British Columbia

Analytical Laboratory Technical Assessment

- On March 6 and 7, 2003, GLNPO conducted a site visit at the analytical laboratory
- The visit was designed to determine the extent to which work on this project conforms to the procedures outlined in the QAPP dated August 20, 2002 and the proposal submitted for the project

Analytical Laboratory Technical Assessment

- The visit was conducted by the following EPA staff from GLNPO and the EPA Region 5 Central Regional Laboratory (CRL), assisted by GLNPO's contractor, CSC:
  - Louis Blume, GLNPO Quality Manager and Team Leader for the visit
  - George Schupp, Deputy Director for CRL
  - Dr. Wayne Whipple, Organic Chemist, CRL
  - Dr. Harry McCarty, Senior Scientist, DynCorp

Analytical Laboratory Technical Assessment

- Overall, the findings from the site visit were quite positive
- The site visit team found that:
  - The laboratory facilities employed for this project are well designed and maintained
  - The staff are well trained and supervised and everyone was responsive and helpful during the visit

Analytical Laboratory Technical Assessment

- Eight recommendations were made to improve the program
- In general, all of the suggestions have been incorporated

Analytical Laboratory Technical Assessment

- Analytical laboratory site visit response
  - The QAPP has been amended to:
    - Expand on staff training
    - Revise discussion and evaluation of data completeness
    - Remove discussion of field duplicates as they are not included in the study

Analytical Laboratory Technical Assessment

- Analytical laboratory site visit response
  - The SOPs have been modified including adding a list of analytes and QC sample performance criteria and corrective actions
  - Incorporated a monitoring protocol for DDT and endrin degradation in the injection port
  - Testing a 5973 GC-MS for future purchase
  - Determined minimum sample size to meet precision requirements for mercury
  - Developed an improved method to reduce the coating of lipid in the mercury analytical system
  - Developed a QA summary sheet for tracking aggregate QA data
  - Installed battery-operated thermometers for all freezers

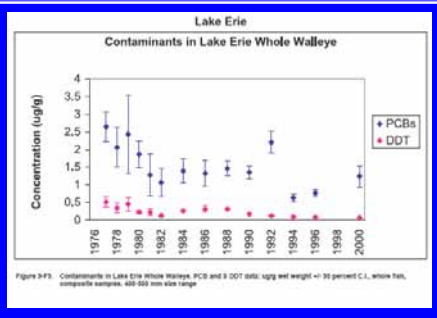
Technical Assessments

- Audit of sample preparation laboratory, Axys Analytical Laboratories
  - Conducted by Office of Water during the National Lake Fish Tissue Study (NFS)
    - Conducted May 22, 2001 by Bill Telliard of OW and CSC contractor
    - Audit concerned operating procedures, facilities, equipment, and documentation for sample preparation and analysis under the NFS.
    - Overall conclusion: Based on the quality of data being produced and the responsiveness to problems Axys is among the highest quality organics laboratories that EPA OW has contacted
  - Report on file

Challenges

- Is current sampling and analytical design sufficient to meet project goals and objectives?
  - Element 1?
  - Element 2?
- Are data representative to support current uses and interpretation?
  - Element 1?
  - Element 2?

Example Data Uses



2002 Great Lakes Binational Toxics Strategy

Challenges

- QMP and historical document development
  - What was the basis for the sampling and analytical design?
    - E.G., Are sites for lake trout representative of whole lake and how was this determined?
    - If this was determined in the past, can we be sure that the sites are currently representative of entire lake for all target analytes?
  - Data Quality Objective process and statements
  - Where do we want to go from here?

Challenges

- Data availability
  - Are data available to the public?
  - What level of quality control information is provided with the data?
    - Some QC data such as blanks, matrix spike data (for mercury) and other performance check results, are not included with the 1999/2000data
    - Narratives will summarize results based on information provided by the PI and can be provided with the data
    - Quality control flags are included with the data

GLENDA *for Fish*

Great Lakes Environmental Database System

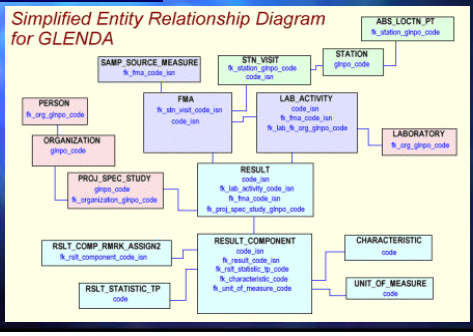
Kenneth W. Klewin
U. S. Environmental Protection Agency
Great Lakes National Program Office

GLENDA – *overview*

- Oracle 9i on Win XP Pro. server
- GLENDA GUI app (in Powerbuilder)
- Normalized, relational database of over 300 tables: reference data (methods, units, codes), projects, stations, personnel, field sampling info, lab results
- More info at: www.epa.gov/greatlakes/monitoring/data_proj/glenda/index.html

GLENDA – *structure*

Simplified Entity Relationship Diagram for GLENDA



GLENDA – *purpose & scope*

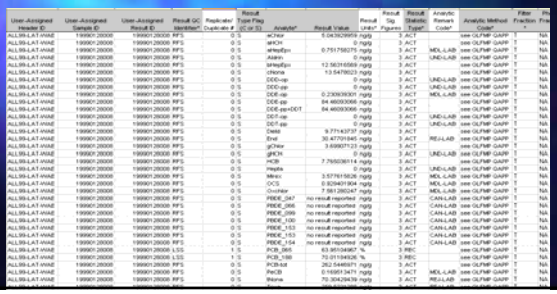
- Data warehouse for multi-media, cross-program data of documented quality
- Water Chemistry
- Atmosphere Chemistry
  - dry dep., precip., vapor, partic.
- Sediment
- Biota
  - Fish, plankton, benthos

GLENDA – *typical metadata*

- Project - objectives, workplan, QAPP, participants
- Personnel – roles, organization, contact info
- Stations – locations, roles (rationale)
- Methods – collection, analysis methods
- Data Quality - QC samples, analysis time, analyst, batches, field and lab comments, result flags

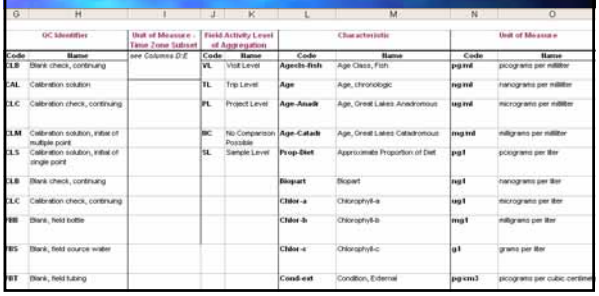
GLENDA – *data upload file*

- From Excel files in specified format



GLENDA - *data upload cont.*

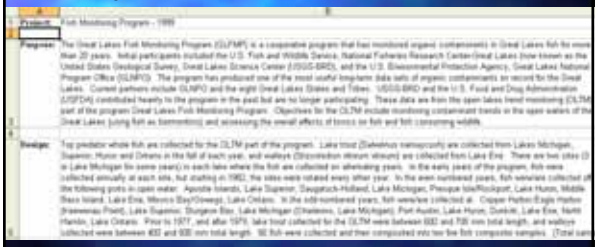
- Lists of allowable codes included



QC Identifier		Unit of Measure - Take Zone Subset	Field Activity Level of Aggregation		Characteristic		Unit of Measure	
Code	Name	see Columns D:E	Code	Name	Code	Name	Code	Name
CLB	Blank check, continuing		VL	Visit Level	Agecls-fish	Age Class, Fish	pg/ml	picograms per milliliter
CAL	Calibration solution		TL	Trip Level	Age	Age, chronologic	ng/ml	nanograms per milliliter
CLC	Calibration check, continuing		FL	Project Level	Age-Anadr	Age, Great Lakes Anadromous	ug/ml	micrograms per milliliter
CLM	Calibration solution, initial of multiple point		BC	No Comparison Possible	Age-Catadr	Age, Great Lakes Catadromous	mg/ml	milligrams per milliliter
CLS	Calibration solution, initial of single point		SL	Sample Level	Prop-Diet	Approximate Proportion of Diet	pg/l	picograms per liter
CLB	Blank check, continuing				Biopart	Biopart	ng/l	nanograms per liter
CLC	Calibration check, continuing				Chlor-a	Chlorophyll-a	ug/l	micrograms per liter
FBB	Blank, field bottle				Chlor-b	Chlorophyll-b	mg/l	milligrams per liter
FBS	Blank, field source water				Chlor-c	Chlorophyll-c	g/l	grams per liter
FBT	Blank, field tubing				Cond-ext	Condition, External	pg/cm3	picograms per cubic centimeter

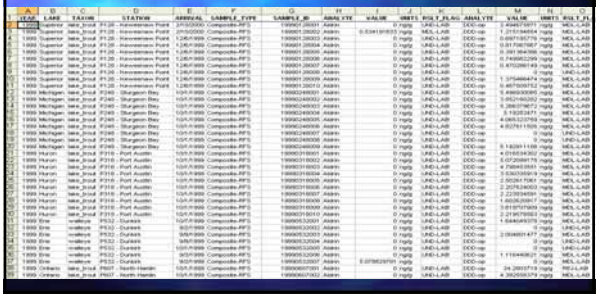
GLENDA – *fish output*

- Project information



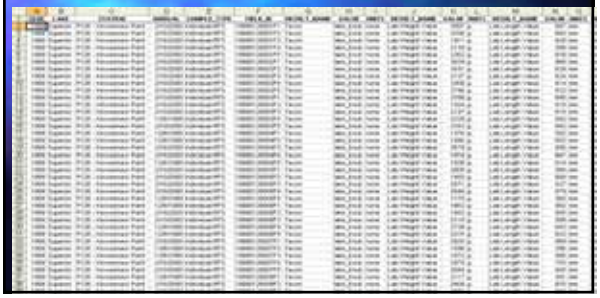
GLENDA – *fish output cont.*

- Tissue chemistry



GLENDA – *fish output cont.*

- Individual fish details



GLENDA – *output & availability*

- By request (phone, email)
  - Ken Klewin 312-886-4794
    klewin.kenneth@epa.gov
- Web site – files via http
  - www.epa.gov/greatlakes/lmmb/drp.html
- Live database query
  - Prototype only
  - Through CDX?

Michigan's Fish Contaminant Trend Monitoring Program

Bob Day
Michigan Department of Environmental Quality
Water Bureau

FISH CONTAMINANT MONITORING PROGRAM GOALS

- Evaluate the need for sport fish consumption advisories and commercial fishing regulations.
- Identify spatial and temporal trends in water quality.
- Evaluate whether existing programs are effectively eliminating or reducing chemical contamination.

MICHIGAN'S FISH CONTAMINANT MONITORING PROGRAM

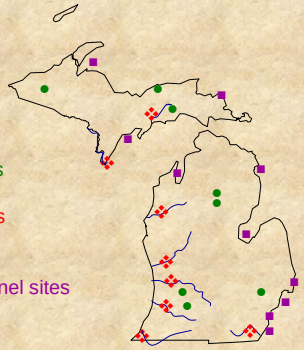
- **Edible Portion Monitoring** (about 70% of the analytical budget)
- **Whole Fish Trend Monitoring** (about 25% of the analytical budget)
- **Caged Fish Monitoring** (about 5% of the analytical budget)

Michigan's Whole Fish Trend Monitoring Program

- Initiated in 1990
- Multiple Species at Great Lakes and Connecting Channel Stations
- Whole, adult fish are analyzed individually
  - Mercury and chlorinated organic contaminants analyzed at all sites
  - Dioxin and furan congeners analyzed at 4 Great Lakes sites
- 10 samples per species per sampling event
- Sites are targeted for collection every 2 to 3 years

26 Fixed Stations

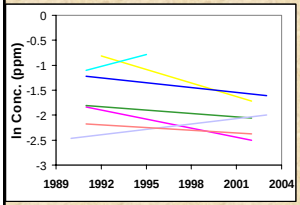
- 8 inland lake sites
- 8 inland river sites
- 10 Great Lake or Connecting Channel sites



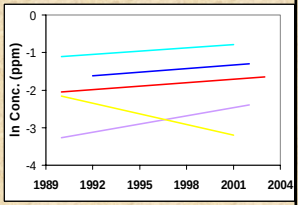
Michigan's Whole Fish Trend Monitoring Program

General Conclusions:

Mercury



Inland Lakes and Rivers

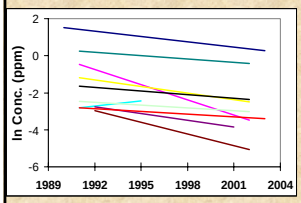


Great Lakes and Connecting Channels

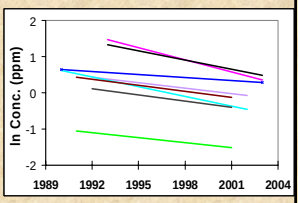
Michigan's Whole Fish Trend Monitoring Program

General Conclusions:

Total PCBs



Inland Lakes and Rivers

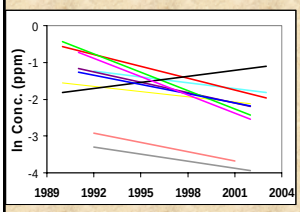


Great Lakes and Connecting Channels

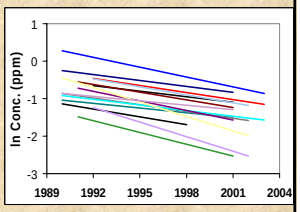
Michigan's Whole Fish Trend Monitoring Program

General Conclusions:

Total DDT



Inland Lakes and Rivers

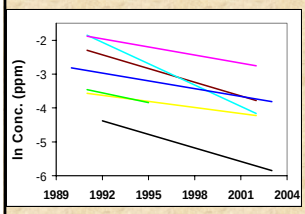


Great Lakes and Connecting Channels

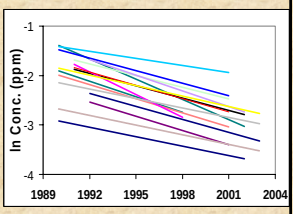
Michigan's Whole Fish Trend Monitoring Program

General Conclusions:

Total Chlordane



Inland Lakes and Rivers



Great Lakes and Connecting Channels

Michigan's Whole Fish Trend Monitoring Program

General Conclusions:

•Detected statistically significant trends or Minimum Detectable Trends of less than +/- 5% per year in 85% of the trends analyses.

•Detected statistically significant trends or Minimum Detectable Trends of less than +/- 10% per year in 96% of the trends analyses.

Peer Review of Michigan's Whole Fish Trend Program

In 2001, the MDEQ hired Exponent to review the whole fish trend monitoring program. The review included:

- Review and summary of literature
- Survey of monitoring programs/experts
- Review of data from other monitoring programs
- Review of MDEQ data

Peer Review of Michigan's Whole Fish Trend Program

In 2003, Exponent produced:

Fish Contaminant Monitoring Program: Review and Recommendations

- Summarized a number of issues relevant to monitoring fish contaminant trends.
- Included 17 options and recommendations for MDEQ to consider.

Peer Review of Michigan's Whole Fish Trend Program

In 2003, the MDEQ hired the Great Lakes Commission to facilitate a peer review of Exponent's recommendations

20 fish contaminant monitoring experts were provided copies of Exponent's report and invited to participate in a peer review workshop.

Participants reviewed each recommendation and provided advice to the MDEQ regarding implementation.

The Great Lakes Commission developed workshop proceedings:

Michigan Fish Contaminant Trend Monitoring Strategy Peer Review Workshop

Peer Review Recommendations

Key question: Should hydrophobic fish contaminants be lipid-normalized?

Recommendation: Most agreed that lipids should not be considered in trends analyses unless lipids change over time. In these cases, lipids should be used as covariates in multiple regression or ANOVA models.

Key question: Should analyses be controlling for age rather than or in addition to length/weight?

Recommendation: Most agreed that age information should be collected and considered in trends analyses.

Peer Review Recommendations

Key question: Should MDEQ stratify sampling by fish size or consider size in post-sampling statistical analyses?

Recommendation: Most agreed that MDEQ should select a wide range of sizes and account for the influence of size with statistical techniques.

Key question: Should MDEQ consider fish gender in its sample or statistical analyses?

Recommendation: Most agreed that it was important to consider gender in trends analyses given that contaminant concentrations can vary between gender in some species (particularly walleye).

Peer Review Recommendations

Key question: Should food chain exposure be monitored directly or indirectly?

Recommendation: Consider analyzing delta nitrogen and delta carbon to help identify changes in the food chain.

Additional information available online:

www.michigan.gov/deq

Then click on: Water

Then click on: Water Quality Monitoring

Then click on: Assessment of Michigan Waters

Then click on: Fish Contaminants

Available reports include:

- **2003 Fish Contaminant Monitoring Report**
- **FCMP Review and Recommendations Report**
- **Trend Monitoring Workshop Proceedings**

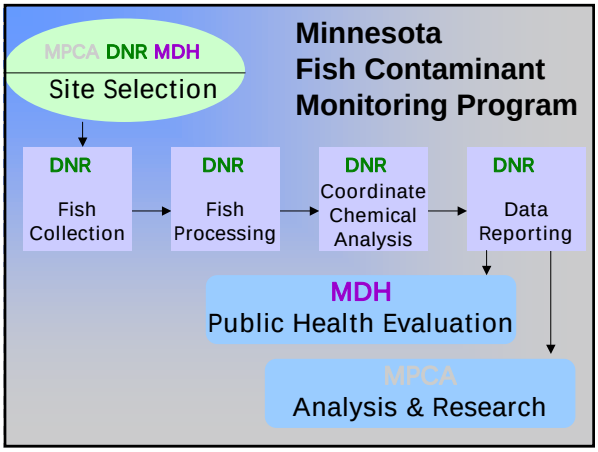
Minnesota Fish Consumption Advisory Program

Pat McCann
February 7, 2005

Presentation Outline

- Overview of MN Fish Contaminants Monitoring Program (MFCMP)
  - Data collection and use
- Fish consumption advice
- How GLNPO data are used

Minnesota Fish Contaminant Monitoring Program

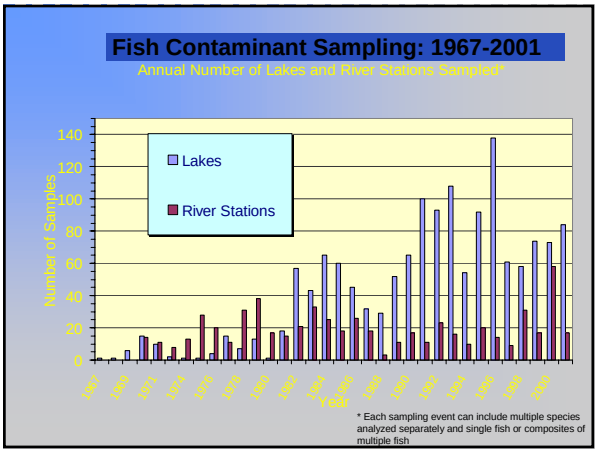


Outcomes of MFCMP

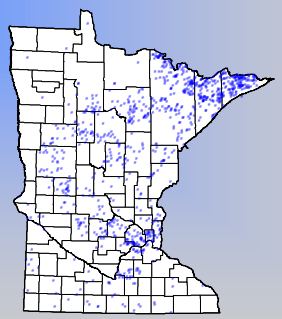
- Fish consumption advice
- Mercury cycling research
- Trend analysis
- Identification of impaired waters
- Evaluation of potential harm of bioaccumulative pollutants

Data Demographics

- Testing of fish began in 1967
- 23,000 data records (~15,000 since 1990)
- ~1000 of 5,500 fishing lakes sampled



Sampling Locations - Lakes



Site Selection

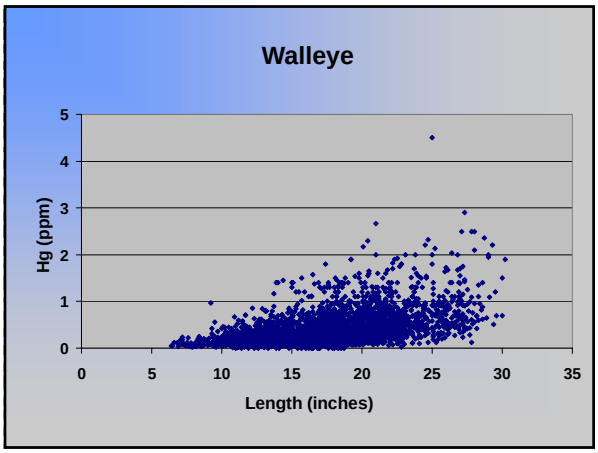
- DNR population assessment sites
- Fishing pressure
  Major waters (~5year sampling cycle)
  - 11 large lakes
  - Lake superior
  - Large rivers
- Trends and research
- Geographic coverage
- Known or suspected contamination

Fish Collection

- Species
  - One composite each - bottom feeder and panfish
  - Ten individual top predator: walleye, northern pike or bass
- Anatomy
  - Skin-on fillet

Contaminants in MN Fish

- PCBs – Lake Superior & major rivers
- Mercury – statewide issue



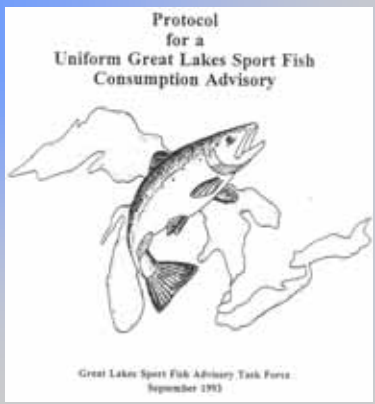
Other Data Sources

- State Program
  - Historical screening- pesticides, organochlorines and metals
  - Toxaphene in lake trout
- Other states, tribes, agencies
- Grants ex. PBDEs in Lake Superior
- PCA research – emerging contaminants research
- Site data – dioxins, PFOA/PFOS
- National studies - supports mercury and PCB concerns
- GLNPO – looking forward to receiving data

Risk Assessment Approach

- US EPA methods
- IRIS RfD's
- Great Lakes Protocol

- Safe dose approach - If exposure is below the safe dose there should be no adverse health effects



Great Lakes Protocol for PCB-based Consumption Advice

- Safe dose = 0.05 µg PCB/kg-body wt/day
  - Based on weight of evidence for developmental and reproductive effects
- Meal size/body weight ratio
  - 227g meal/70kg person
- 50% reduction factor for loss of contaminant during cleaning and cooking

Mercury consumption advice

- Same assumptions as Great Lakes Protocol (except no loss factor for mercury)
- Since 1990 MDH has used a two-tiered approach, providing separate advice for the general population and women of childbearing age and children

U.S EPA Mercury RfD

- 2001 RfD = 0.1 µg mercury/kg-body wt/day
  - developmental effects in Faroese children of mother's exposed to mercury through consumption of fish and seafood
- 1985 RfD = 0.3 µg mercury/kg-body wt/day
  - CNS effects in Iraqi adults exposed through eating contaminated grain

What fish tissue level is safe to eat once/week?

$$\frac{\frac{7\text{ days}}{\text{meal}} \times \frac{70\text{kg person}}{227\text{g fish/meal}} \times 0.05\ \mu\text{g PCB/kg-bw/day}}{50\%\text{ loss of PCBs}}$$

= 0.2 µg PCB/g fish (ppm)

Meal Advice Categories – Mercury Women and Children

Unlimited consumption	< 0.06 ppm Hg
1 meal / week	> 0.06 - 0.2 ppm Hg
1 meal / month	> 0.2 - 1.0 ppm Hg
Do not eat	> 1.0 ppm Hg

Consumption Advice

- Site specific
- Statewide

- Printed Brochures
- Web Information
  - MDH
  - DNR

Publications

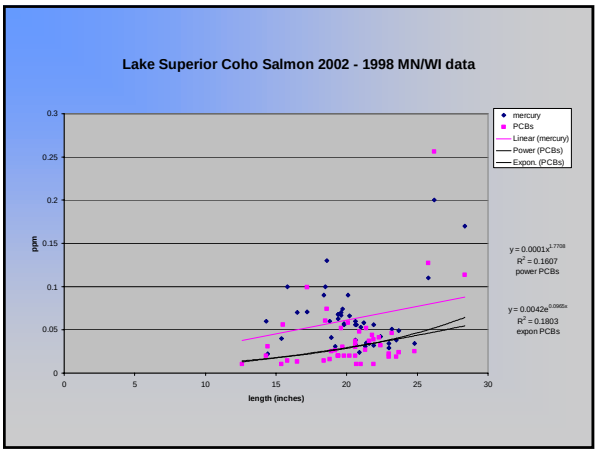
- General Statewide Advice
  - "Eat fish often?" and Mom's Guide brochures
  - MDH web site
  - DNR Fishing Regulations
- Site Specific Advice
  - MDH web site
  - DNR Lake Reports - web and hard copy

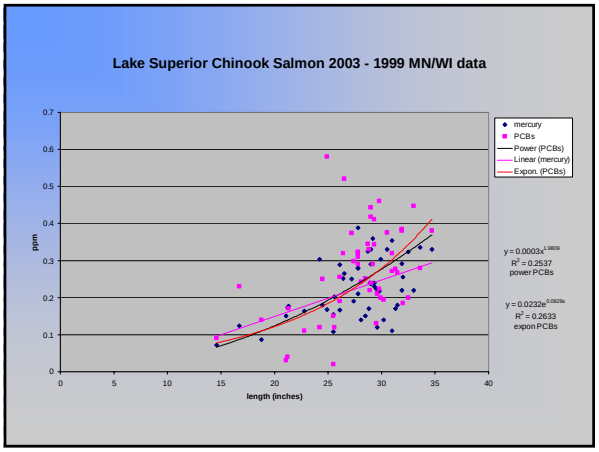
Data Analysis

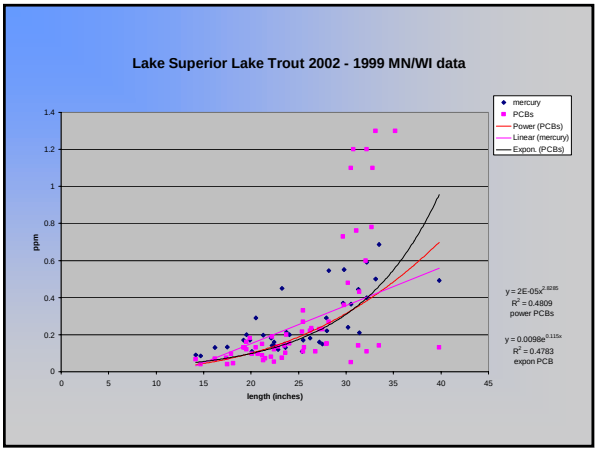
- Site specific
  - Use means: by waterbody, species and size class groupings
- Statewide
  - Weight of evidence approach
- Border waters

"Weight of Evidence" Approach

- Data Analysis
  - Means and regression analysis
    - By species and geographic location
- Harvest rates
- Input from other state agencies
- Consistency with neighboring states
- Consistency with site-specific advice format







Lake Superior Advice

Fish Species	Unlimited	1 meal per week	1 meal per month	1 meal every 2 months	Do not eat
Chinook Salmon		Less than 25"	Larger than 25"		
Coho Salmon	Less than 18"	Larger than 18"			
Pink Salmon	All sizes				
Lake Trout		Less than 23"	23 to 34"	Larger than 34"	
Siscowet Lake Trout			Less than 25"		Larger than 25"
Rainbow Trout		All Sizes			
Brown Trout		All Sizes			
Lake Whitefish		All Sizes			
Lake Herring		All sizes			
Smelt	All sizes				

Use of GLNPO fish Data

- Include in assessment for Fish Consumption Advisory
- Evaluate status of chemicals we don't monitor (including emerging contaminants)
  - Need detection limits appropriate for human health risk assessment
- Trends (including mercury) – helps determine which analytes we should measure
- Compare analytical results of common analytes

New York State Fish Monitoring and Fish Advisories Re: Great Lakes Fish Monitoring Program

Tony Forti, NYSDOH
Larry Skinner, NYSDEC

New York State Agencies

- NYS Department of Environmental Conservation: Fish Monitoring
- NYS Department of Health: Fish Advisories

Objectives of NYS Fish Monitoring Efforts

- Temporal trends
- Source identification
- Remedy effectiveness
- Fish advisories

Data Quality

- Sample handling/documentation
- Laboratory selection
- Detection limits
- Quality Assurance/Quality Control

Analytes

- "Traditional"Analytes: PCBs (Aroclors vs. congeners), chlorinated dioxins & furans, OC pesticide compounds, mercury, cadmium
- "New" Analytes: PBDEs, PFOS compounds, other metals (e.g. thallium)

Data Elements re: Fish Advisories

- Whole fish vs. fillets
- Composites vs. individual analyses
- Arithmetic mean contaminant levels
- Specific waterbodies/locations
- Species
- Number of samples

Data Elements re: Fish Advisories (continued)

- Fish sizes/ages (length-based advisories)
- Lipid content
- Time of year (season)

2004/2005 Data Review

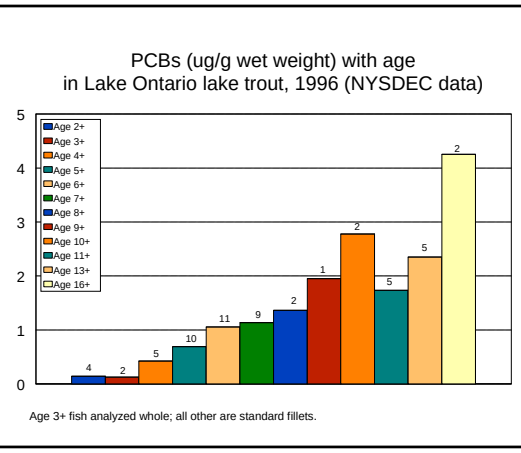
- Collections from more than 40 waters
- Multiple locations on major waters: Hudson, Mohawk and Niagara Rivers
- 2 to 3 fish species/water body
- 5 to 10 specimens per species, individual analyses (usually)
- Mercury, PCBs, organochlorine pesticides

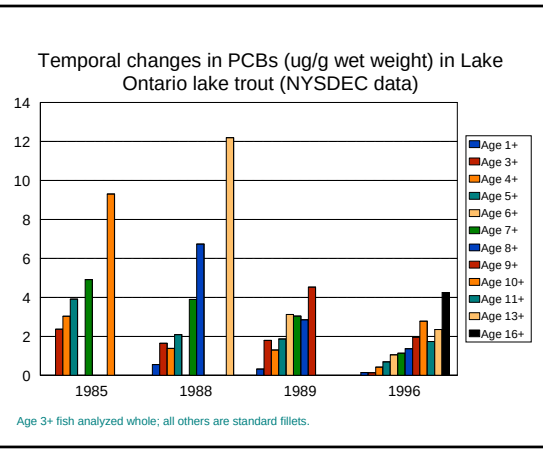
NYS Great Lakes Identified Advisory Contaminants

- Lake Erie: PCBs
- Lake Ontario: PCBs, organochlorine pesticides (mirex), and dioxin

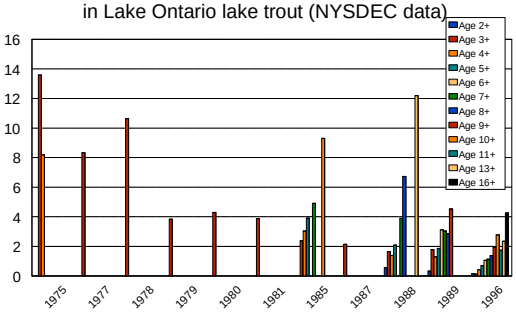
GLFMP Data in NYS Waters: Lake Ontario

- Salmonids
- PCBs and organochlorine pesticides



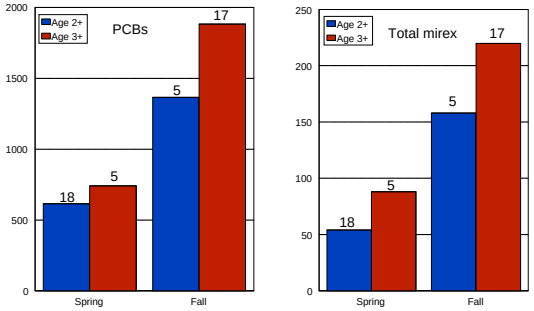


Temporal changes in total PCBs (ug/g wet weight by age in Lake Ontario lake trout (NYSDEC data)



Age 3+ fish analyzed whole; all others are standard fillets.

Changes in Lake Ontario brown trout PCBs and Mirex (ug/kg, wet weight) with season and age (NYSDEC data)



General Advisory

Eat no more than one meal (one-half pound) per week of fish from the state's freshwaters + some waters at mouth of Hudson River (except as recommended in specific advisories).

High Risk Group Advisory

Women of childbearing age, infants and children under the age of 15 should not eat any fish species from specific waters listed.

Specific, Restrictive Advisories (general pop. only)

- *1 meal/mo.* or *eat none*
- Waterbody and species specific
- >90 NYS waterbodies

EPA's National Lake Fish Tissue Study: A Unique Partnership

Great Lakes Fish Monitoring Program Review

February 2005

Leanne Stahl
Program Manager
Office of Science & Technology

1

Presentation Overview

- Background
- Study Design
- Accomplishments
- Preliminary Results
- Final Data Analysis
- Future Milestones

2

A Unique Study

- First national study of contaminant levels in freshwater fish based on a statistical design
- Largest set of chemicals ever studied in fish
- Largest project being conducted under EPA's Persistent, Bioaccumulative, and Toxic (PBT) Pollutants Program

3

Objective

- *The objective of the National Lake Fish Tissue Study is to estimate the national distribution of the mean levels of selected persistent, bioaccumulative, and toxic chemical residues in fish tissue from lakes and reservoirs in the contiguous United States.*
- Study results will
  - Provide a national baseline for assessing progress of pollution control activities
  - Identify areas that require further investigation

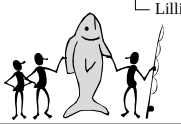
4

EPA Fish Study Team

- **OW**
  - **OST**
    - **SHPD**
      - Leanne Stahl
    - **OGWDW**
      - Cindy Simbanin
  - **ORD**
    - **NHEERL**
      - **EMAP**
        - Tony Olsen

Regional Coordinators

- Hilary Snook, Region 1
- Jim Kurtenbach, Region 2
- Frank Borsuk, Region 3
- Alan Auwarter, Region 4
- Pete Redmon, Region 5
- Phil Crocker, Region 6
- Lorenzo Sena, Region 7
- Toney Ott, Region 8
- Peter Husby, Region 9
- Lillian Herger, Region 10



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Study Partners

- Extensive national network of partners supporting the National Lake Fish Tissue Study, including:
  - 47 States
  - 3 Tribes
  - 2 Other Federal Agencies
    - National Park Service
    - Tennessee Valley Authority
- Partners participate in the following activities:
  - Lake reconnaissance
  - Fish collection
  - Annual data review

6

Sampling Design

- Sample 500 lakes and reservoirs in the lower 48 states that were selected according to a statistical sampling design
- Categorize lakes and reservoirs into 6 size ranges
- Collect two 5-fish composites (predator and bottom dweller) from each site
- Apply consistent methods nationwide for sample collection and analysis
- Re-sample 10% of the lakes to evaluate sampling variability

7

Target Chemicals

- EPA is analyzing the fish tissue for 268 chemicals, including PCB congeners and breakdown products
  - 2 metals (Hg and As [5 forms])
  - 17 dioxins/furans
  - 159 PCB congener measurements
  - 46 pesticides
  - 40 semi-volatile organics (e.g., PAHs)
- EPA recently added analysis of PBDEs for Year 4 samples only

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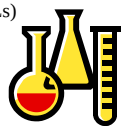
Fish Sampling QA/QC

- Consistency in fish collection, handling, and shipping through:
  - Orientation/training of study participants
  - Implementation of detailed SOPs
  - Distribution of identical field sampling materials to all sampling teams
  - Preparation of fish samples in a controlled laboratory environment

9

Tissue Analysis QA/QC

- Consistency and comparability of fish tissue analysis maintained throughout the study by using:
  - Same standard analytical method for each chemical
  - Same laboratory for each type of analysis
  - Consistent method detection limits (MDLs) and QC acceptance criteria standards
  - Standard data reporting formats and standard process for data quality assessment



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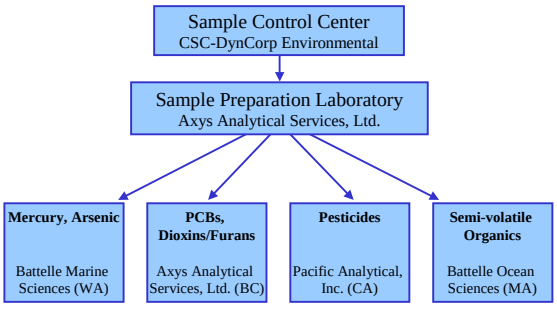
Tissue Analysis Network



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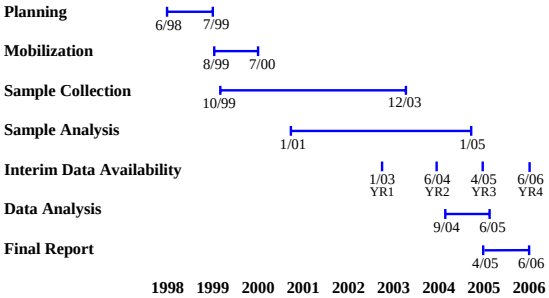
Key Fish Study Activities



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Accomplishments

Planning	•Study design development •Statistical selection of lakes •Target chemical selection
Mobilization	•10 orientation/training workshops •Production of QA Plans and Field Sampling Plan •Mapping and reconnaissance of 900 lakes

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Accomplishments

Fish Sampling & Analysis	•Fish collection at 500 lakes •Completion of fish tissue analysis •Development of annual analytical QA report
Public Outreach	•Development of fish study website (www.epa.gov/waterscience/fishstudy) •Production of data CDs for public release

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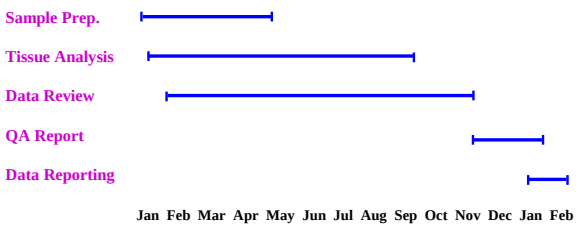
500 Sampling Locations

15

Annual Data Cycle



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Data Review/Distribution: Year 2

- Automated data review for all methods except pesticides
- 65 data packages from labs for analysis of 230 fish composite samples
  - Analytical data for about 330 chemicals
  - SCC review of over 5 million data elements
- Distribution of Year 2 data packages to 60 participating state, tribal, and federal agencies

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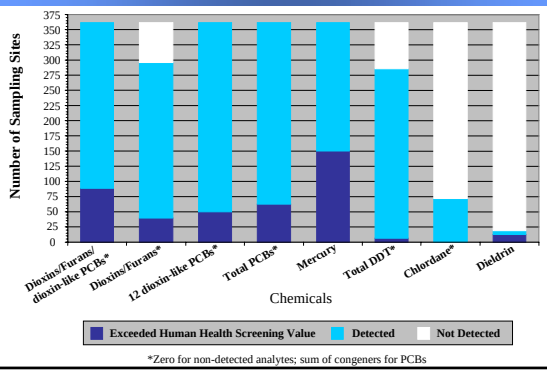
Preliminary Data Summary for Predators (Fillet Analysis: Years 1-3)



*Zero for non-detected analytes; sum of congeners for PCBs

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Statistical Analysis

- EPA will begin analyzing fish study data once the full 4-year analytical data set is available.
- Data analysis will consist of the following core components:
  - Estimates of national means and percentiles
  - Cumulative distribution function plots for chemicals and composite types with sufficient data

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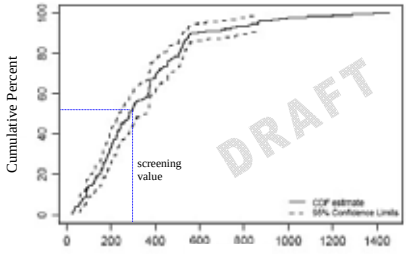
Preliminary National Distribution

Cumulative Distribution Function for Mercury
in 361 Predator Composites (Preliminary, Weighted Data)



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Statistical Analysis (cont.)

- National maps of chemicals by composite type for mercury, PCBs, and dioxins/furans
- Estimate of sampling variability based on replicate sample data
- Analysis of various sample factors, including:
  - Number of fish in the composite
  - Size effects
  - Species effects

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Future Milestones

Short-term (2005)

- Produce Year 4 Analytical Data QA Report
- Distribute Year 4 data to states/other partners
- Prepare Year 3 data CD for public release
- Complete statistical analysis of 4-year fish tissue data set

Long-term (2006)

- Submit draft final report for peer review
- Complete indicators for EPA's Report on the Environment
- Produce final fish study report
- Upload data into EPA's STORET

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SIZE Vs AGE Vs Tissue TYPE

DOES IT MAKE A DIFFRENCE ?

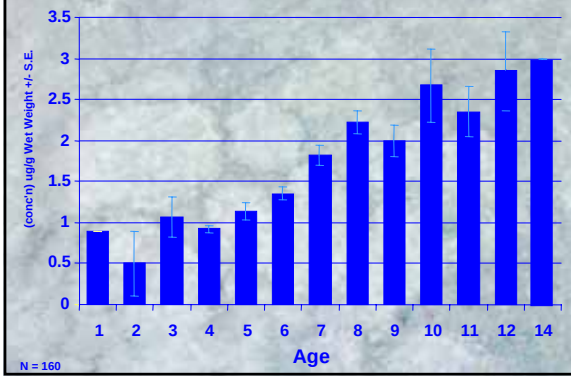
LAKE SUPERIOR – LAKE TROUT 2000 - 2001

Age	N	Total Length (Size Range) (cm)
2+	4	26.5 - 34.0
3+	3	35.0 - 38.0
4+	37	40.0 - 55.0
5+	31	41.0 - 66.0
6+	20	48.0 - 62.0
7+	6	56.0 - 73.0
8+	6	55.0 - 67.0
9+	3	62.0 - 74.0

LAKE ONTARIO – LAKE TROUT 2000-2001

Age	N	Total Length (Size Range) (cm)
3+	10	36.0 - 46.0
4+	18	45.0 - 51.0
5+	58	49.0 - 71.0
6+	63	60.0 - 73.5
7+	60	60.0 - 78.0
8+	37	64.0 - 85.0
9+	36	62.0 - 87.0
10+	17	64.0 - 81.0
11	7	62.0 - 83.0
12	12	70.0 - 84.0
13	8	71.0 - 79.5
14	1	75.5
15	3	61.0 - 91.5
16	5	74.0 - 81.0
17	2	71.0 - 81.0

Concentrations of Total PCB in Lake Ontario Lake Trout



N = 160

LAKE TROUT WHOLE FISH/ FILLET (SKINLESS DORSAL MUSCLE) CONTAMINANT RELATIONSHIPS

PCB

N = 86

(PCB)f = 0.427 (PCB)w + 0.047 TL. – 2.214

Where ( ) = wet weight concentration

f = fillet
w = whole fish
TL = total length (cm)

Data Source: Fisheries and Oceans

LAKE TROUT WHOLE FISH/ FILLET (SKINLESS DORSAL MUSCLE) CONTAMINANT RELATIONSHIPS

TOTAL DDT

N = 86

Lake Ontario – (DDT)f = 0.395(DDT)w + 0.023TL – 1.090

Lake Superior - (DDT)f = 0.604(DDT)w + 0.003TL – 0.191

Hg

N = 86

(Hg)f = 1.000(Hg)w + 0.002TL – 0.035

Data Source: Fisheries and Oceans

LAKE TROUT LIPID LEVELS WHOLE FISH /MUSCLE RATIOS

	% LIPID	PORTION OF WHOLE FISH LIPID LEVEL
WHOLE FISH	12.1 (5.0 -15.4)	----------
DORSAL FILLET (SKIN OFF)	4.6 (0.9 – 9.1)	32.4 %
SKIN _ON FILLET	8.7 (2.4 – 15.0)	68.3 %