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Work Group Report on Benefits and Risks of Great Lakes Fish Consumption

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Because the Great Lakes Water Quality Agreement (GLWQA) focuses on a wide variety of water-quality issues facing the Great Lakes Basin Ecosystem, the Commission created a GLWQA "Priority" setting process to focus on what it considers the most pressing issues. The Commission and its advisory bodies review and revise these Priorities as needed every two years. After receiving input from the public on its Priorities work, the Commission prepares Biennial Reports to governments on the status of Great Lakes water quality.

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"Can I eat the fish?"

Fish are an important part of a healthy diet and contain several important nutrients. Although recent publications have detailed benefits of consuming seafood, very limited data are currently available on the content of omega-3 fatty acids in fish from the Great Lakes System. Monitoring of polychlorinated biphenyls and methylmercury levels in Great Lakes fish has been useful for establishing fish consumption advisories. However, levels of emerging contaminants have not been adequately quantified and thus have not been suitably monitored in Great Lakes fish.

This Work Group report highlights the challenge of evaluating the "net" risks and benefits of consuming Great Lakes fish. The report also identifies important needs concerning monitoring, research, public health communication and policy in order to assist individuals make better personal dietary decisions aimed at maximizing and protecting human health.

In addition to preparing this report, the work group will host a session on the Benefits and Risks of Great Lakes Fish Consumption on Wednesday, October 7, 2009 at the GLWQA Biennial Meeting in Windsor, Ontario. Using the work group report as background material, work group members will present findings and discuss the issue with the public to elicit various perspectives and to inform the Commission's 15th Biennial Report.

Work Group Report on the Risks and Benefits of Great Lakes Fish Consumption

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I. Background and Methods

A. Problem Statement:

Fish are an important part of a healthy diet and contain several important nutrients, such as high-quality protein, vitamins, minerals and long chain omega-3 polyunsaturated fatty acids (PUFA). Eating fish may reduce the risk of heart disease, hypertriglyceridemia, diabetes and other chronic and inflammatory illnesses. But fish (purchased or caught) often contain contaminants that can be harmful to human health. The balance between the risks and benefits of consuming fish is complex. This report highlights the challenge of evaluating net risks and benefits of consuming fish, and identifies important needs concerning monitoring, research, public health communication and policy in order to help individuals make better personal dietary decisions aimed at maximizing and protecting health.

1. PUFA and human health:

PUFA are essential to the human diet, but we lack the ability to synthesize them. There are two major types of PUFA, omega-3 fatty acids, which have the first double bond at the third carbon from the terminal methyl group, and omega-6 fatty acids, which have the first double bond at the sixth carbon. Omega-3 fatty acids, which are major components of neuronal, retinal and cardiac muscle membranes, include eicosapentaenoic acid (EPA), with 20 carbons, and docosahexaenoic acid (DHA), which has 22 carbons. Physiologically, EPA and DHA can be synthesized from their parent compound, α linolenic acid (ALA), (an 18 carbon fatty acid). However, the biosynthetic pathway can be slow and quite inefficient, particularly when omega-6 fatty acids comprise the dominant fatty acid in an individual's diet. Arachidonic acid is a 20-carbon omega-6 fatty acid and is a step in the synthesis of prostaglandins. Since omega-6 fatty acids compete with omega-3 fatty acids for the same conversion enzymes, an excess of omega-6 fatty acids can result in reduced conversion/biosynthesis of EPA and DHA from ALA (Simopoulos, 2008; Surette, 2008).

Individuals can obtain additional EPA and DHA from natural sources such as fish (especially fatty fish), fish oil and algae. These longer chain omega-3 fatty acids are synthesized by marine microorganisms and bioconcentrate in the aquatic food chain. All seafood contains some of the longer chain omega-3 fatty acids, but the concentrations vary. Fatty fish contain more DHA and EPA than lean fish. Colder water species have higher concentrations than warmer water species (Brett and Muller-Navarra, 1997; Philibert et al., 2006). Varying concentrations of omega-3 fatty acids in fish also depend on the season and position in the food web.

Alternatively, EPA and DHA also can be derived from other nutrient sources, such as eggs, milk, cheese and other foods, which have been enriched with omega-3 fatty acids by supplementing animal and poultry diets with fish oils (Hargis, Van Elswyck, and Hargis, 1991; Meluzzi et al., 2000) or through genetic engineering. While some "omega-3 fatty acid enriched" eggs have been fortified by adding fish oil to poultry diets, others have been fortified by adding ground flaxseed to the poultry diet. The difference is that the first approach results in eggs containing EPA and DHA, while the second approach creates eggs which primarily contain only ALA, not EPA or DHA (Caston and Lesson, 1990; Cherian and Sim, 1991).

ALA is naturally abundant in dark green, leafy plants, some grains, flax seed, canola oil, linseed oil and some nuts, especially walnuts. Contemporary Western lifestyles and food preferences generally fail to provide adequate omega-3 fatty acids and usually result in a disproportionately high intake of omega-6 acids, which are present in most meats, as compared to omega-3 fatty acids (Surette, 2008). The omega-6 to omega-3 ratio in common Western diets is reportedly as high as 16:1 (Simopoulos, 2008). According to some investigators, human evolution (and human health) favors a more balanced ratio, such as 1 to 5:1. When the consumption of omega-6 containing foods is unrestricted, omega-6 fatty acids dominate the extracellular environment throughout the body, and are thus able to achieve greater incorporation into the membranes of virtually all cells. This creates an imbalance at the cellular level, and results in enhanced expression of omega-6-mediated functions and reduced or inhibited expression of omega-3-mediated functions. Since omega-6 fatty acids lead to the production of pro-inflammatory eicosanoids, in excess they cause inappropriately augmented immune reactions, possibly leading to excessive inflammation, allergic reactions, autoimmune diseases and thrombus formation (Calder, 2006; Surette, 2008). Conversely, the reduced incorporation of omega-3 into cell membranes deprives the individual of appropriate anti-inflammatory effects that result from the actions of omega-3-derived eicosanoids.

2. Benefits of fish consumption and omega-3 fatty acids:

When prepared with little or no added fat (e.g., steamed, baked, grilled), fish provide a dietary source of high-quality, easily digestible protein that is relatively low in saturated fats. Low rates of consumption of fish occur in many populations throughout the world. The U.S. population reportedly has one of the lowest blood levels of DHA in the world (Rice, 2008). Fish intake by Canadian women in their childbearing years is also among the lowest in the world (Brenna et al., 2007), and there is evidence suggesting that some pregnant women in Canada may be DHA deficient (Innis and Friesen, 2008). Deficiencies of longer-chain omega-3 fatty acids have been linked with numerous health concerns including cardiovascular and inflammatory diseases, as well as significant impairment of cognitive, visual and neurological development of fetuses and children (Simopoulos, 2008). As a consequence, the Institute of Medicine, the World Health Organization and several other major health organizations have published recommendations concerning dietary consumption of fish (Psota, Gebauer, and Kris-Etherton, 2006; IOM 2007; Koletzko, 2008; AHA 2009). There is significant disparity among the recommendations of these various organizations, which reflects considerable uncertainty in our understanding of these nutrients, both with regard to optimal intake levels and health effects.

There are a number of studies that indicate that fish consumption and/or omega-3 supplementation reduces the risk of sudden death following a heart attack (Burr et al., 1989; Marchioli et al., 19992002; Yoyokama et al., 2007). The mechanism proposed is that omega-3 fatty acids increase membrane fluidity of cardiac muscle, which reduces the risk of arrhythmias (Leaf, Kang and Xiao, 2008). However it is not clear that fish consumption reduces the risk of development of a heart attack (Burr, Dunstan and George, 2005). Very high intake of omega-3 fatty acids (levels than can be achieved only by supplementation rather than fish consumption) results in a lowering of serum triglyceride levels (Harris, 2001; Balk et al., 2004). Others have hypothesized potential benefits on inflammatory and autoimmune conditions such as rheumatoid arthritis, asthma and inflammatory bowel disease (Calder, 2006; Stephenson, 2004; Mickleborough and Rundell, 2005) and diabetes (Sirtori and Galli, 2002), although evidence for these effects is not definitive. The cognitive function of preterm infants who are not breast fed clearly benefit from omega-3 supplementation of formula (Fleith and Clandinin, 2005) and some results indicate that even term infants benefit from increased omega-3 intake (Birch et al., 2005). Hibbeln, Ferguson, and Blasbalg (2006) have provided some evidence that omega-3 fatty acid supplementation has beneficial effects on cognitive function in dementia and some psychiatric diseases. There are, however, some concerns of adverse effects of very high omega-3 intake. Doses which exceed 4 grams per day may diminish clotting function and increase bleeding times (U.S. DHHS, 2005) and cause altered immune system function which may not always be beneficial (Virella et al., 1989; Rees et al., 2006).

3. Risks of Consuming Fish:

The most serious environmental exposure issue for fish (and consumers of fish) is chemical contamination of our oceans, rivers and lakes, including the Great Lakes. The chemical pollutants of greatest concern include methyl mercury, polychlorinated biphenyls (PCBs), dioxins/furans and chlorinated pesticides such as DDT and its metabolite, DDE. These chemicals, which are absorbed through the gills and ingested by fish, collect in their tissues through a process called bioaccumulation. Predatory fish species consume smaller species and thus acquire additional exposure to these chemicals. As the fish continue to grow larger, they contain increasingly higher concentrations of these contaminants. When humans consume these fish, they too become exposed to these chemicals. Since humans are also physiologically unequipped to metabolize and excrete these substances efficiently, significant ingestion results in accumulation of these chemicals and may impose serious threats to human health.

Methyl mercury is a potent neurotoxicant, and the developing brain is more susceptible to impairment as a result of exposure than is the adult brain (Rice, 2008). Methyl mercury binds to protein and therefore bioaccumulates in fish muscle. For this reason, consumption of aquatic foods has become the major etiology of human exposure to methyl mercury (IOM, 2007). While the greatest concern with regard to methyl mercury exposure is the deficit in cognitive function seen with prenatal and early life exposure, methyl mercury also is known to increase the risk of cardiovascular disease, an action which has been found to partially counteract the beneficial effects of omega-3 fatty acids (Guallar et al., 2002).

PCBs, dioxins/furans and chlorinated pesticides bioaccumulate in the fatty tissues of all animal-derived foods, including fish. Fish from contaminated waters are a major source of human exposure to these contaminants, but they are also found in the lipids of beef, pork, poultry and dairy products (IOM, 2003). These compounds are well documented to be associated with a variety of adverse health effects. The most potent dioxin congener has been identified as a proven human carcinogen, while PCBs and most chlorinated pesticides are rated as probable human carcinogens by the World Health Organization (Steenland et al., 2004). Dioxins and PCBs suppress immune system function (Dallaire et al., 2006), disrupt thyroid (Brucker-Davis, 1998) and sex hormonal function (Richthoff et al., 2003) and are associated with elevated risk of diabetes (Lee et al., 2006; Codru et al., 2007) and cardiovascular disease (Goncharov et al., 2008). Chlorinated pesticides such as DDT and its metabolite, DDE, are associated with elevated risk of cancer (Cocco, Kazerouni, and Zahm, 2000), impaired neurodevelopment in children (Torres-Sanchez et al., 2007) and altered sex hormonal function (Ouyang et al., 2005). While the exposure of the general population to compounds such as PCBs has decreased since the 1970s and early 1980s, current exposures are still associated with increased risk of several diseases (Diamond and Harrad, 2009), and special concern remains for subpopulations exposed through recreational, cultural or subsistence fishing due to their reliance on fish from high risk regions such as the Great Lakes (Cole et al., 2003; IOM, 2007; Mahaffey, Clicker, and Jeffries, 2008). In addition to these legacy contaminants, other chemicals that have been less studied also have been found in fish, including polybrominated diphenyl ethers (PBDEs), polychlorinated diphenyl ethers, polychlorinated naphthalenes, polychlorinated paraffins and perfluorochemicals.

All the contaminants mentioned above other than methyl mercury and the perfluorochemicals are lipophilic, and therefore are found in higher concentrations in fatty fish, older fish and carnivorous fish. Thus many of the fish species that have relatively high levels of omega-3 fatty acids also have relatively high levels of these lipophilic chemicals.

Several federal, state/provincial and regional environmental agencies regularly monitor contamination levels in local fishing areas, and issue consumption advisories that recommend that people limit or avoid eating certain species/sizes of fish caught from certain places (EPA, 2009; Queens Printer of Ontario Ministry of the Environment, 2009). However there is currently no accepted algorithm/method/guide to compare net risks to benefits of consuming fish. This is true for fish consumption in general, and is particularly true for consumption of Great Lakes fish.

B. Assessment of Condition:

The Work Group considers two contaminants, methyl mercury and PCBs, to be of particular concern because of their known toxicity and because of the levels of these chemicals found in Great Lakes fish. Important approaches to risk management (Sunderland, 2007; Del Gobbo et al., 2009) include consumption advisories concerning the existing methyl mercury and PCB contamination as well as efforts directed toward controlling active sources of continuing contamination (such as coal-fired power plants which release mercury, atmospheric transport of PCBs into the Great Lakes, and destruction of existing stocks of PCBs around the Great Lakes). The remediation of sediment, which remains contaminated with mercury and PCBs, is also a significant part of risk management. The Work Group seeks to assess the state of knowledge regarding risk and benefits of fish consumption, identify important gaps in knowledge and determine whether present information allows one to determine whether there is a net benefit or a net hazard to the consumption of Great Lakes fish.

In general, sport fish from lakes Michigan, Ontario and Huron have the highest levels of PCBs, DDT and dieldrin. Sport fish from Lake Superior have the highest levels of toxaphene and those from Lake Ontario have the highest levels of mirex (Environment Canada and U.S. EPA, 2008). Each of these chemicals is rated as a probable human carcinogen and also has a variety of non-cancer adverse health effects (Huang et al., 2006).

The Ontario Ministry of the Environment (in collaboration with the Ontario Ministry of Natural Resources) and U.S. states and tribes have monitored contaminant levels in edible parts of fish, and issued consumption advisories for Great Lakes fish since the 1970s. The U.S. Environmental Protection Agency (U.S. EPA) and Environment Canada have had ongoing, long-term efforts to monitor contaminant levels in top predator fish species (walleye in Lake Erie and lake trout in other Great Lakes). These programs have been designed to evaluate ecosystem health trends, but are not suitable to develop fish consumption advisories. Further, both Environment Canada and U.S. EPA run a long-term archive facility of top-predator whole fish samples which provides an opportunity to perform retrospective analyses and examine long-term trends of chemicals of emerging concern. These monitoring data have been invaluable in raising public awareness of the potential health threat from contaminated fish and encouraging governmental action to prohibit activities that produce certain noxious chemicals. There has been a substantial decrease in levels of many legacy contaminants found in top predator fish over the past decades [although recently, contaminant levels may be decreasing so slowly that levels appear to be static (Hickey, Batterman, and Chernyak, 2006; Bhavsar et al., 2007)]. U.S. EPA's Great Lakes Open Lakes Monitoring Program has recently been expanded to include contaminants of emerging concern and will be used as a surveillance tool for emerging chemicals.

Long-term trends of contaminant levels in top predator fish vary for other chemicals that are still in use or for which there are uncontrolled sources feeding into the Great Lakes. These emerging contaminants may pose additional health threats to Great Lakes fish as well as to humans following exposure. Various policy approaches have been or are being developed to address these contaminants of emerging concern. However, opportunities exist to improve on designing tools for effective control of these chemicals. For example, an agreement to discontinue the production of penta and octa formulations of PBDEs was signed by the U.S. EPA and chemical producers in 2004. Canada prohibited the production, importation and use of penta and octa PBDEs in 2006 and deca PBDEs in 2008. However, the use of deca formulations of PBDE continues in many U.S. states, despite evidence that these can debrominate in the aquatic environment under realistic conditions, and form the more toxic lower brominated congeners (LaGuardia, Hale, and Harvey, 2007). Moreover neither country has legislative provisions that cover importing these formulations in finished products.

Currently, Great Lakes fish consumption advisories (Environment Canada and U.S. EPA, 2008) exist due to the following contaminants:

Lake Superior – dioxin, PCBs, methyl mercury, toxaphene

Lake Huron – dioxin, PCBs, methyl mercury

Lake Michigan – dioxin, PCBs, methyl mercury, chlordane, DDT

Lake Erie – dioxin, PCBs, methyl mercury

Lake Ontario – dioxin, PCBs, methyl mercury

The causes of existing contaminant levels in Great Lakes fish include global as well as local sources of atmospheric deposition of contaminants such as mercury and PCBs, inputs of compounds such as PCBs from wastewater treatment facilities, emissions of dioxins and mercury from combustion sources and non-point source loadings of current and historical use of pesticides from agricultural and urban watersheds. In addition, a considerable mass of PCBs and mercury remain in the sediment of major tributaries and nearshore waters of the Great Lakes.

C. Work Group Approach and Activities:

The Work Group held a one-day conference and planning session on March 10, 2008, and a conference call for Work Group members on August 21, 2008. In addition, the Work Group organized a technical session conducted on May 21, 2009, at the annual International Association of Great Lakes Research (IAGLR) conference. In late 2008, and early 2009, white papers were commissioned on behalf of the Work Group on the topics of: (a) rates of consumption of Great Lakes fish; (b) contaminant levels in Great Lakes fish; (c) health effects of methyl mercury and PCBs; (d) levels of omega-3 fatty acids in Great Lakes fish; (e) health effects of omega-3 fatty acids. In addition to the Work Group, the International Joint Commission's (Commission) Health Professionals Task Force and the Ontario Ministry of Natural Resources provided support for the development of these white papers. On the basis of information from the white papers and the presentations at the IAGLR session, the Work Group has prepared this report and will submit a review on the topic to a peer-reviewed journal.

II. Science and Policy

A. State of Science, Research, and Monitoring:

A review of the literature reveals very limited data on the content of omega-3 fatty acids in freshwater fish from the Great Lakes System. Compositional analyses as reported by Dr. Paul Addis and his group (Wang et al., 1990) on fish from Lake Superior, and the recent contributions from Dr. Bruce Holub (Holub, 2009) concerning fish in Lake Superior and Lake Erie are notable exceptions. These reports reveal that several common fish species in Lakes Superior and Erie contain concentrations of omega-3 fatty acids, particularly EPA and DHA, that are comparable to those in fatty marine fish. There is, however, considerable need for additional information on levels of omega-3 fatty acids in fish from Lakes Huron, Michigan and Ontario. Work is currently underway, on behalf of the Work Group, to compile currently available compositional data as well as new compositional data on various samples of fish from the Great Lakes System. Studies carried out with fish consumers from the Great Lakes and the St. Lawrence River did not observe an association between consumption of fish from these waters and levels of omega-3 fatty acids, although they did find positive results as a result of fish consumption from other sources (Cole et al., 2002; Godin et al., 2003; Philibert et al., 2006).

Monitoring of the legacy contaminant levels in Great Lakes fish has been useful for establishing fish consumption advisories. However, levels of emerging contaminants have not been adequately quantified and thus have not been monitored in fish tissue. In addition there is currently a relative lack of good information on health hazards of these compounds. Consumption guidelines need to be developed for these emerging contaminants.

Several researchers have sought to understand and/or quantify the benefits versus risks of consuming fish (e.g., Foran et al., 2005; Guevel et al., 2008; Mozaffarian, 2009; Ginsburg and Toal, 2009). Several methods have been proposed to quantify the benefits/risks, but the incommensurability of the health outcomes makes the analysis particularly challenging.

There is a major need for quantifying human blood levels of Great Lakes contaminants derived from the consumption of Great Lakes fish, particularly of those contaminants known to have adverse human health effects. Levels of omega-3 fatty acids and health outcomes in the same population are also needed. The health outcomes can be derived from medical history as well as through clinical chemistry indicators of disease and neurobehavioral testing.

B. State of Governance, Policy, Management and Resources:

Funding constraints have been a major problem in the past both for ecologic monitoring and the study of human health effects. Increased resource levels for Great Lakes restoration activities are urgently needed, and efforts to better quantify existing conditions and to study human health effects should be recognized for funding. There also are deficiencies and limitations in the fish consumption advisories as a consequence of variation in contaminant levels in fish from different waters, insufficient information on the levels and health benefits of omega-3 fatty acids and uncertainties in determining the risk-benefit relations. Of particular concern is that the U.S. FDA action and tolerance levels set for interstate commerce are not strictly health-based and do not address risks of concurrent exposure to mixtures of contaminants (see Hites et al., 2004). These levels may not be adequately protective.

A comparative analysis of advisory Web pages issued by 48 states has recently been completed, and the findings of the analysis confirmed the difficulty of effectively assessing and communicating information about multiple contaminant exposure from fish consumption (Scherer et al., 2008). As discussed in the 1999-2001 Priorities Report to the International Joint Commission, in 1986 the Council of Great Lakes Governors charged state health officials with the development of a uniform Great Lakes Sport Fish Consumption Advisory. After many years of discussion, the Great Lakes states were able to reach a consensus on a uniform advisory ("Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory", Great Lakes Sport Fish Advisory Task Force, 1993). This advisory primarily concerned PCBs, since PCBs have been the dominant chemical of health concern in open waters of the Great Lakes. In 2007, the Great Lakes states amended the protocol to include mercury. In addition, recognizing that fish consumption had potential health benefits, also in comparison with other food sources, health scientists agreed with the following statement and recommended that all state advisories include a benefit statement.

"When properly prepared, fish provide a diet high in protein and low in saturated fats. Many doctors suggest that eating a half-pound of fish each week is helpful in preventing heart disease. Almost any kind of fish may have real health benefits when it replaces a high-fat source of protein in the diet. You can get the health benefits of fish and reduce contaminants by following this advisory."

The Guide to Eating Ontario Sport Fish is distributed through selected Liquor Control Board of Ontario stores, bait and tackle outlets, Wal-Mart and Canadian Tire stores, Ontario Travel and Tourism Offices, Parks, Service Ontario outlets and other government offices. Paper copies can also be requested via phone, e-mail, online form or snail mail. The Guide is available in an electronic format online.

Although the Province of Ontario and all U.S. Great Lake states publish fish consumption advisories, they are increasingly difficult to find in most U.S. jurisdictions since many are primarily available on the Internet. The increased utilization of the Internet as a communication tool poses a challenge in effective communication with some sensitive populations who may lack Internet access or knowledge concerning its use. The populations most at risk and who lack knowledge of risks of fish consumption are also those least likely to use the Internet. The states and provinces would benefit from additional resources to be used in the development of more comprehensive outreach and education campaigns. Research is needed to address the question of where individuals access fish consumption information and how this information influences fish consumption decisions (Scherer et al., 2008).

III. Findings and Recommendations

A. Monitoring Needs:

- Programs monitoring levels of contaminants in Great Lakes fish need to be maintained and expanded to include contaminants of emerging concern. Monitoring programs also should determine levels of omega-3 fatty acids in fish.
- There is an urgent need to monitor levels of contaminants as well as omega-3 fatty acids in individuals who consume significant amounts of Great Lakes fish.

B. Educate the Public on the Information Related to Fish Consumption:

- Effective ways to provide accurate, easily understood and consistent information about fish consumption to the public regardless of political jurisdiction, especially directed at sensitive and vulnerable populations, need to be identified, developed and implemented.

C. Research Needs:

Additional research is required to fill the following gaps in knowledge:

- Additional information on the health effects of the various chemicals found in Great Lakes fish, both singly and as a mixture of chemicals. Information on the emerging chemicals of concern is especially essential.
- Study of Great Lakes fish consumers with monitoring of omega-3 fatty acids, at least methyl mercury and PCB if not also some of the emerging chemicals, together with neurobehavioral tests and clinical chemistry indicators of disease, so as to rigorously determine risks vs. benefits of Great Lakes fish consumption.
- The relationship between consumption of the various fish species of the Great Lakes and levels of omega-3 fatty acids in humans throughout their lifespan.

- Methods to evaluate the benefits versus risks posed by fish consumption through interdisciplinary analysis.

- Dietary interventions that might reduce the adverse health effects of exposure to contaminants in fish (e.g., selenium, fruit consumption).

- The effects of anthropogenic stresses on ecosystem health and on contaminant and omega-3 fatty acid content in fish.

- Development of more effective methods to shape the effectiveness of communicating fish consumption guidance, especially among sensitive and/or vulnerable populations.

- Research to address possible effects of climate change, population growth and migration and urban land use on levels of both contaminants and omega-3 fatty acids.

D. Policy Needs:

- Policies, legislation and action need to be strengthened to reduce external emissions and internal sources (e.g., contaminated sediment, in use and stored PCBs) into the Great Lakes.

- Consistent fish consumption advisories should be developed that are based on consideration of both the benefits of omega-3 fatty acid consumption and the hazards from the mixture of contaminants found in Great Lakes fish.

IV. Next Steps

A. Summary of Actions and Resources Needed by Identified Order of Government or Entity:

Federal, provincial and state governments should undertake actions necessary to minimize human health risks due to the consumption of Great Lakes fish. These actions should include steps to reduce contaminant inputs to the Great Lakes, removal, if appropriate, of contaminated sediment from the Great Lakes and enhancement of communication to the public regarding risks and benefits of consuming Great Lakes fish. In addition, increases in funding for the research topics identified above are also needed from these levels of government.

B. Future Role for the Commission and Great Lakes Water Quality Agreement Priority Process:

An opportunity exists for the Commission to more actively engage the public in an interdisciplinary, ecosystem-based approach toward defining the net risks/benefits of consuming fish from the Great Lakes. An expanded approach in the 2009-2011 priority cycle could build on the foundation of technical information that was compiled during the 2007-2009 cycle and interact directly with researchers, agency personnel and interested representatives of sensitive populations to consider a quantitative approach for risk/benefit analysis.

V. Conclusions:

Unfortunately, it is not possible to determine whether the benefits of Great Lakes fish consumption outweigh the risks posed by ingestion of contaminants currently found in the fish. At present the public should be advised to follow fish consumption advisories issued by federal and state/provincial governments.

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Background Papers URL

The following materiel is gathered at:

http://www.ijc.org/en/priorities/2009/fish-consumption/appendix

Health Effects of MeHg and PCBs, by Mary Turyk, Ph.D and Lisa Nicholson, Ph.D

The Health Benefits of Omega-3 Fatty Acids, by Sheila Bushkin-Bedient, M.D., and David O. Carpenter, MD

Fish Consumptions by Residents of the Great Lakes Basin, by Mary Turyk, Ph.D

Contaminants in Fish Consumed by Residents of the Great Lakes, by Mary Turyk, Ph.D

xls file of Data by Mary Turyk, Ph.D

Omega-3 Fatty Acid Contents of Great Lakes Fish, by Professor Bruce J. Holub, University of Guelph

Powerpoint presentation by Professor Holub