UP TO THE GILLS:

2009 UPDATE ON POLLUTION IN GREAT LAKES FISH

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EXECUTIVE SUMMARY

The Great Lakes are a globally significant ecological resource. They provide drinking water for 40 million people. They power homes and industries across their 521,000 km basin, and beyond. They are intensively used for recreation by a huge population along their 17,000 km coastline. They are also home to almost 4,000 species of fish, plants, and animals.

Yet the Great Lakes suffer from decades of abuse, including pollution from industrial, municipal, and agricultural sources. Pollution finds its ways into the bodies of Great Lakes residents through air and water, but also via the consumption of sports fish from the lakes. While there are clear health benefits from eating fish, consumers need to be aware of the health risks associated with particular species from specific locations. The *Guide to Eating Ontario Sport Fish,* published by the Ontario Ministry of the Environment, is intended to serve this purpose, and is designed to warn consumers about with Great Lakes fish they should and should not eat.

This report examines trends in Great Lakes fish consumption advisories from 2005 to 2009, focusing on 13 regions across the lakes and drawing from the last three editions of the *Guide to Eating Ontario Sport Fish*. The results are discouraging. While there have been some modest improvements in the last two years, a fifth of the 2009 advisories examined in this report were for 'zero' consumption levels, meaning that it is not safe to eat such fish at all. This is unacceptable, from recreational, economic, and human health perspectives.

Consumption restrictions are low in Lake Superior. In Lake Huron and Georgian Bay, there have been some improvements since 2007; however, restrictions are still severe for larger fish. Lake Erie advisories have remained essentially unchanged since 2007, yet they are again quite high for larger fish. Lake Ontario advisories are the most severe of all the Great Lakes; 40% of the advisories surveyed for this report were at the most restrictive 'zero' consumption level. Disturbingly, many highly restrictive advisories for Lake Ontario were placed on mid-sized and even small fish, which are usually lower in contaminants. Ultimately, Great Lakes fish advisories indicate continued high levels of toxic contaminants in fish tissue.

Based on its findings, this report makes eight recommendations on how to improve both the quality of designing and reporting of fish consumption advisories to ensure that they reach consumers that are most at risk, as well as how to decrease the levels of contaminants in Great Lakes fish by limiting the release of contaminants into and around the lakes.

INTRODUCTION

The Great Lakes represent a vast and globally important storehouse of ecological resources. They provide drinking water for about 40 million people, power for homes and industry, a transportation network, countless natural spaces for recreation, and an abundance of habitat for wildlife. While the Great Lakes fishing industry has declined substantially over the last century, there are still more than 395,000 anglers who fish in the Canadian Great Lakes each year[1], and commercial Great Lakes fisheries pump an estimated $100-$150 million into Ontario's economy alone.[2]

But pollutants from centuries of industrial, commercial and urban development along the shores of the Great Lakes have contaminated many regions so intensely that the fish are no longer safe to eat. In 2007, approximately 14 billion litres of raw sewage were released into the Great Lakes in Ontario alone.[3] In 2002 alone, 1.1 billion kilograms of industrial pollution was released into the air, water and land of the Great Lakes basin, including 28 million kilograms directly into the water.[4]

As a result of this pollution, mercury, PCBs, dioxins, furans, pesticides and a host of other chemicals have climbed the food chain in such high concentrations that eating restrictions have been imposed for much of the Great Lakes' fish species and angling sites. The food web has become a pyramid of contamination. And the problem is not going away. Contaminants like PCBs can persist in sediments for many years, endangering not only our health but that of future generations.

The health benefits of eating fish are undeniable. This report should not discourage people from eating fish, including those found in the Great Lakes. In fact, because of chemical and biological contamination of various sorts, other sources of protein may have as many, if not more, health risks associated with their consumption. However, fish advisories due to damaging levels of toxic contamination in Great Lakes fish are a potent warning that in order to safeguard the Great Lakes' status as a vital resource and an international treasure, we must dramatically reduce pollution in the basin.

Decisions about consuming Great Lakes fish are informed by fish consumption advisories. In Ontario, these advisories take the form of biannual guides published by the Ministry of the Environment. They say how many fish can be safely eaten in a month, according to species, fish length, and location.

Fish advisories have three main objectives: (1) providing information about chemical contaminants in fish, (2) reducing exposure by educating consumers, and (3) identifying benefits of fish consumption.[5]

The Ministry of the Environment published the 25th edition of the *Guide to Eating Ontario Sports Fish* in March 2009. It is a must-have for every angler in Ontario. The MOE has monitored contaminants in Ontario fish since 1976, but each biannual guide indicates only the most recent data on fish contaminant levels. This raises important questions about the contamination of Great Lakes fish. How are levels of contaminants changing from year to year? Are fish more or less contaminated now than they were years ago? What can we do to reduce toxic chemicals in fish?

This report examines fish advisories as an indicator of fish contamination levels over time to inform Great Lakes residents of pollution in the Great Lakes basin. It also provides important information to help citizens make healthier choices when eating fish caught in the lakes.

Based on this analysis, the report provides recommendations for improving the system of fish advisories in Ontario and for taking a preventative approach to promoting public health by reducing the pollution that causes fish consumption advisories. These recommendations are timely; in June 2009 the Canadian and US governments jointly announced that they would update the Great Lakes Water Quality Agreement (GLWQA), the bi-national accord protecting the chemical, physical, and biological integrity of the waters of the Great Lakes basin. The governments of Canada and the United States, as well as the relevant states and provinces, have an opportunity to work together in restoring and protecting the health of the Great Lakes, both for ourselves and for future generations.

METHODOLOGY

Based on their popularity among anglers, eight fish were selected for this study: Lake Trout, Rainbow Trout, Coho Salmon, Chinook Salmon, Walleye, Carp, Northern Pike and Whitefish. Many are top predators and highly prized sports fish. Because of their high position in the food chain, these predatory fish are vulnerable to bioaccumulation of toxic substances.

Data on the advisories and supporting statistics were collected from the 2005-2006, 2007-2008, and 2009-2010 editions of the *Guide to Eating Ontario Sports Fish* for small (35 cm), medium (55 cm), and large (75 cm) sizes of fish. To create more manageable datasets and more informative illustrations, 13 of the 59 regions of the Great Lakes were selected as outlined in the *Guide*. The regions were selected based on the presence of at least four of the 8 species listed above and in order to provide a geographically and demographically representative sample. These regions include: two locations in Lake Superior, three in Lake Huron, three in Lake Erie and Lake St. Clair, four in Lake Ontario, and one on the St. Lawrence River.

The GLWQA establishes Areas of Concern (AOCs) – locations recognized within the Great Lakes basin as regions where the beneficial uses for humans and wildlife (such as habitat, water quality and fish consumption) are degraded. Four of the regions examined in this report have been designated as AOCs.

A map with coloured illustrations shows the fish consumption advisories for various species of fish in each of the 13 regions for three different sizes. Fish size is particularly important to fish consumption advisories because many of the toxic substances accumulate over time in fish tissue. Generally speaking, larger fish are older and have accumulated higher levels of pollutants in their tissue than smaller ones.

On the map, the colour of each fish indicates the approximate number of fish an adult can safely eat on a monthly basis: turquoise for eight servings, brown for four, yellow for two, orange for one and red for zero. The closer the number is to zero, the higher the contamination level in the fish. The specific number of meals an adult can safely eat per month is listed on the coloured fish illustrations. Women of child-bearing age and children under 15 are advised to consume considerably less fish than is listed in these advisories.

The fish consumption advisories for 2005 and 2007 have also been included on the maps to help illustrate what has happened over time. These advisories are shown as coloured lines beneath the fish symbol for each species at each size. This data shows trends in the fish advisories and toxicity over the past two years for each species and size. Data from 2005 and 2007 was used instead of earlier fish advisories because over the past decade, a variety of changes have been made to human consumption standards, but these standards have remained relatively consistent since 2005. Two exceptions are for dioxins and furans and PCBs, whose exposure limits have become less and more stringent, respectively.

Another shortcoming of the fish advisories data is the lack of samples available to calculate fish advisories. In some cases for which samples of a particular size of fish are not available, the government bases its advisory on the last historical sample available or on a regression relationship between age and size. As a result, cases where the standard has remained the same may in fact merely indicate that no fish of that species were caught at that size.

This study examines fish toxicity using indicators such as the total number of advisories in the regions studied, the number of advisories that were unchanged from 2007 to 2009 (understanding that this could be a result of not having any new samples), the number of advisories that became more and less severe during these times, and the total number of the advisories for the least restrictive (8 meals per months) and most restrictive (zero meals per month) categories.

It is important to remember that this is by no means intended to act a comprehensive health study. The *Guide to Eating Sports Fish in Ontario* should be consulted before eating any fish from the Great Lakes.

FISH CONSUMPTION ADVISORIES: GREAT LAKES TRENDS

KEY FINDINGS

LAKE SUPERIOR *Advisory Stats:*

Total # of advisories examined – **15**

Advisories with no change – **12**

Advisories that became more restrictive/ less restrictive 2007-2009 – **1/2**

Most restrictive (zero meals)/ least restrictive (8 meals) 2009 – **0/7**

Lake Superior —

While it is the largest freshwater lake in the world, Lake Superior's basin is the least populated of the Great Lakes. Despite the limited urban settlement, industrial development is widespread. The mills, factories and quarries that line Lake Superior all contribute to the pollution that leads to fish consumption advisories around the lake. Lake Superior has an extremely long retention period of almost 200 years, meaning it takes almost this time for harmful substances to be flushed out of the system.[6] According to the 2009-2010 *Guide to Eating Ontario Sports Fish*, consumption restrictions for Lake Trout, Salmon and Whitefish are caused by dioxins, furans and PCBs, while restrictions for Northern Pike and Walleye are caused by mercury.

At first glance, Lake Superior seems to have the fewest number of fish advisories, and the severity of the advisories is not as high as in the other lakes. None of the species examined had the most serious category of advisory ("zero consumption") and about half of the fish had the least restrictive consumption advisory placed on them. The only changes between 2007 and 2009 are more restrictive consumption advisories for Chinook Salmon and Rainbow Trout, and a less restrictive one for Lake Trout—all at Goulais Bay. Lake Superior's long retention period, which can prolong chemical exposure to the fish, may be mitigated by its size and the lack of urban growth. These two factors could explain the limited number and severity of the fish advisories and hence a fish contamination level that is lower than those of the other Great Lakes.

Lake Huron —

Lake Huron is the second largest of the Great Lakes in area and has the largest drainage basin (more than 50,000 km^2, twice that of Lake Ontario). The retention time is far less than that of Lake Superior, at just 22 years, and the basin land use is predominantly agricultural. Fish advisory levels in Lake Huron and Georgian Bay are somewhat high, but there have been improvements since the 2007-2008 *Guide*.

LAKE HURON *Advisory Stats:*

Total # of advisories examined – **36**

Advisories with no change – **24**

Advisories that became more restrictive/ less restrictive 2007-2009 – **1/11**

Most restrictive (zero meals)/ least restrictive (8 meals) 2009 – **5/9**

In 24 of the possible 36 categories of fish advisories studied in Lake Huron, there was no change from the 2005 advisories. Eleven advisories became less severe – the best improvement for any of the Great Lakes in the 2009 *Guide*. Nine categories were listed as the least restrictive. One advisory became more severe, and five exhibited the most severe "zero" advisory. Lake Trout, Chinook Salmon, and Carp have the most severe advisories.

Improvements in consumption advisories are most pronounced in the southern portion of the lake. However, advisories nonetheless remain most strict in this portion of the lake, where settlement and industrial development is concentrated. Consumption limits on trout, salmon, and carp are primarily caused by dioxins, furans and PCBs, while those for other species are caused by mercury.

Lake Erie —

The smallest by volume and shallowest of the Great Lakes, Lake Erie also has the shortest retention time, only 2.6 years. Population statistics from 1991 in Canada and the United States suggest the Lake Erie area is the most populated of the Great Lakes, despite its smaller drainage basin and shorter shoreline length.

LAKE ERIE *Advisory Stats:*

Total # of advisories examined – **30**

Advisories with no change – **22**

Advisories that became more restrictive/ less restrictive 2007-2009 – **4/2**

Most restrictive (zero meals)/ least restrictive (8 meals) 2009 – **3/7**

FISH CONSUMPTION ADVISORIES:
GREAT LAKES TRENDS

KEY
LOCATION OF FISH ADVISORY

75cm — *Length of fish*

2009 Fish Advisory

2005 2007 — *2005 Fish Adv. (left); 2007 Fish Adv. (right)*

CHINOOK SALMON — *Species of fish*

8 | 4 | 2 | 1 | 0

The number indicates the total quantity of meals of that species and size of fish that can be safely consumed each month. The combined consumption of all species of Ontario sport fish consumed each month must be taken into account when determining the number that can be safely eaten.

*Note: Consult the **Guide to Eating Ontario Sport Fish** before consumption.*

1 THUNDER BAY
LAKE SUPERIOR

35cm 55cm 75cm
LAKE TROUT

35cm 55cm 75cm
NORTHERN PIKE

35cm 55cm 75cm
WALLEYE

35cm 55cm 75cm
CARP

GOUL
LAKE

35cm
CHINO

35cm
LAK

35cm
RAINB

35cm
NORT

5 LAKE HURON - AREA 5
GRAND BEND TO POINT EDWARD

35cm 55cm 75cm
CHINOOK SALMON

35cm 55cm 75cm
RAINBOW TROUT

35cm 55cm 75cm
LAKE TROUT

35cm 55cm 75cm
CARP

6 LAKE ST. CLAIR

35cm 55cm 75cm
NORTHERN PIKE

35cm 55cm 75cm
CARP

35cm 55cm 75cm
WALLEYE

7 CENTRAL BASIN
LAKE ERIE

35cm 55cm 75cm
COHO SALMON

35cm 55cm 75cm
RAINBOW TROUT

35cm 55cm 75cm
CARP

35cm 55cm 75cm
WALLEYE

8 EASTERN BASIN
LAKE ERIE

35cm 55cm 75cm
COHO SALMON

35cm 55cm 75cm
RAINBOW TROUT

35cm 55cm 75cm
LAKE TROUT

35cm 55cm 75cm
WALLEYE

2
AIS BAY
SUPERIOR

55cm 75cm
OK SALMON

55cm 75cm
E TROUT

55cm 75cm
OW TROUT

55cm 75cm
HERN PIKE

3
LAKE HURON - AREA 3
STOKES BAY TO POINT CLARK

35cm 55cm 75cm
CHINOOK SALMON

35cm 55cm 75cm
RAINBOW TROUT

35cm 55cm 75cm
LAKE TROUT

35cm 55cm 75cm
CARP

4
GEORGIAN BAY
LAKE HURON

35cm 55cm 75cm
CHINOOK SALMON

35cm 55cm 75cm
RAINBOW TROUT

35cm 55cm 75cm
LAKE TROUT

35cm 55cm 75cm
WALLEYE

13
LAKE ST. LAWRENCE
ST. LAWRENCE

35cm 55cm 75cm
NORTHERN PIKE

35cm 55cm 75cm
CARP

35cm 55cm 75cm
WALLEYE

12
LOWER QUINTE
LAKE ONTARIO

35cm 55cm 75cm
CHINOOK SALMON

35cm 55cm 75cm
LAKE TROUT

35cm 55cm 75cm
NORTHERN PIKE

35cm 55cm 75cm
WHITEFISH

9
HAMILTON HARBOUR
LAKE ONTARIO

35cm 55cm 75cm
CHINOOK SALMON

35cm 55cm 75cm
RAINBOW TROUT

35cm 55cm 75cm
CARP

35cm 55cm 75cm
NORTHERN PIKE

10
TORONTO
LAKE ONTARIO

35cm 55cm 75cm
CHINOOK SALMON

35cm 55cm 75cm
LAKE TROUT

35cm 55cm 75cm
CARP

35cm 55cm 75cm
NORTHERN PIKE

11
NORTHWESTERN
LAKE ONTARIO

35cm 55cm 75cm
CHINOOK SALMON

35cm 55cm 75cm
RAINBOW TROUT

35cm 55cm 75cm
CARP

35cm 55cm 75cm
LAKE TROUT

In the 1960s, the lake was declared "dead" due to the decomposition of algal blooms caused by severe nutrient loads from numerous sources, predominantly phosphorus, a fertilizer also found in commercial detergents. Lake Erie, however, has shown a remarkable ability to rebound. Although toxicity levels in the lake are still disturbing, Lake Erie actually has fewer and less restrictive fish consumption advisories than Lake Ontario. Of the 30 possible fish advisories in Lake Erie, 22 had no change, while two became less restrictive and four became more restrictive. Of the 30 advisories, seven were the least restrictive, advising a maximum of eight fish per month, while three were the most restrictive "zero" advisory.

The more severe consumption advisories are found in the central and eastern basin regions. In the Central Basin, there has been little change in advisories between 2007 and 2009. However, many 2009 consumption advisories are still greater than those for 2005, showing that contaminant levels remain unacceptably high. Advisories for larger Coho Salmon and Lake Trout are particularly severe.

Lake Ontario —

LAKE ONTARIO *Advisory Stats:*

Total # of advisories examined – **45**

Advisories with no change – **34**

Advisories that became more restrictive/ less restrictive 2007-2009 – **4/6**

Most restrictive (zero meals)/ least restrictive (8 meals) 2009 – **18/7**

The Lake Ontario basin is the most populated Great Lakes basin on the Canadian side of the lakes. The smallest Great Lake by total land drainage basin area (64,000 km^2) and surface area, Lake Ontario has a relatively short retention period (six years). The vast majority of the water flowing into Lake Ontario comes from Lake Erie, with a small amount contributed by the basin tributaries. Lake Ontario is the final destination for water and contaminants as they exit the Great Lakes system through the St. Lawrence River. It is therefore strongly affected by upstream activities in the other Great Lakes.

Of the four lakes studied, the most severe fish advisories were found in Lake Ontario, including "zero consumption" advisories for large fish of almost every species, in every study region. Out of the 45 fish advisories examined on Lake Ontario, 34 had no change, and 40% of total fish advisories were for zero consumption. Between 2007 and 2009, six advisories became less severe, while four became more severe. However, from 2005 to 2009, increases and decreases in advisory limits were roughly even. The main constant is the extreme restrictiveness of the advisories, indicating high levels of contaminants.

Alarmingly, Lake Ontario "zero consumption" advisories are no longer reserved for the largest fish. Lake Trout, Chinook Salmon, and Carp have particularly strict advisories against their consumption, even for medium-sized fish. The Ontario Ministry of the Environment attributes the contamination mainly to dioxins and furans, with the exception of Walleye and Pike. For these two species, mercury was generally the consumption-limiting contaminant.

The main chemical sources of fish advisories:

Mercury

Exposure to mercury has been known to cause damage to the central nervous system and act as a reproductive toxin, a respiratory toxin, and a carcinogen. Mercury is considered a toxic substance under the *Canada Environmental Protection Act* and is listed as a chemical for virtual elimination in the Binational Toxics Strategy, a Canada-US initiative under the GLWQA. However, it continues to be released across Ontario and the Great Lakes states. For example, Ontario facilities reporting to Canada's National Pollutant Release Inventory in 2006 released 2,853 kg of mercury – the majority of it in industrialized regions close to or bordering the Great Lakes.[7]

Some mercury occurs naturally in the environment, but the major sources of mercury pollution are emissions from coal-fired power plants, mining, incineration and manufacturing. In lake sediments, mercury is converted into highly toxic methylmercury, which can bioaccumulate in the fatty tissue of living organisms, particularly fish living in polluted waters. Fish and other seafood, with methylmercury concentrations 10 to 100 times greater than other foods, are the main sources of methylmercury in the human diet.[8, 9]

Dioxins and Furans

Dioxins and furans are byproducts of industrial processes, particularly incineration. Seventeen of the 210 different dioxins and furans are considered toxic enough to warrant fish consumption advisories. These chemicals can have adverse effects on the liver, skin, immune system, and nervous system, and can cause certain types of cancers.[10] Dioxins and furans can travel long distances, and accumulate and remain in animal body fat for long periods of time, so fish, other meats and milk have higher levels than fruits, vegetables and grains. Dioxins and furans are among a small number of chemicals targeted for "virtual elimination" in the Binational Toxics Strategy. There has been significant progress in reducing dioxin and furan emissions to date,[11] but unacceptably high quantities of the chemicals continue to be released into the Great Lakes system.

PCBs

First manufactured in 1929, polychlorinated biphenyls (PCBs) have been used as ingredients in a number of industrial processes, including the manufacture of coolants and lubricants. PCBs were first detected in the Great Lakes in 1966. Although a North American ban on manufacturing and importing PCBs was put in place in 1977, they continue to be permitted for use in older industrial machinery and processes. PCBs are listed as chemicals for virtual elimination under the Binational Toxics Strategy, and are particularly persistent because they are stored in the bodies of humans and animals for long periods. They can cause skin ailments, numbness in limbs, muscle spasms, chronic bronchitis, nervous system problems, and cancer.[12] In the Great Lake basin, recent studies indicate fish consumption remains the major cause of PCB exposure.[13]

Pesticides

Pesticide exposure is linked to non-Hodgkin's lymphoma, leukemia, neurological problems, reproductive abnormalities, immunotoxicity and cancer.[14] Children are at particular risk from pesticides because they are more vulnerable to the effects and have greater exposure to the chemicals. While some municipalities around the Great Lakes have instituted bans on cosmetic pesticide use, there is still widespread use in the Great Lakes basin for domestic, commercial and agricultural purposes. Toxaphene, an insecticide heavily used in the United State until it was banned in 1990, has in the past triggered significant fish advisories in Lake Ontario, Lake Huron and Lake Superior.

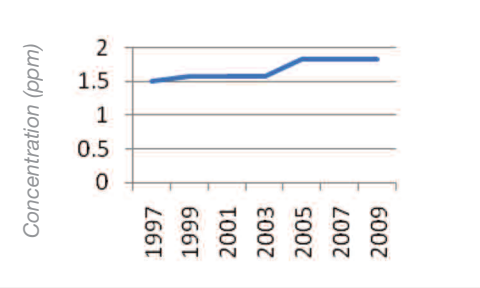
How much is considered toxic?

As scientific knowledge about the health effects of chemicals changes, Health Canada periodically adjusts its 'safe doses' of toxicants—figures that are used as the basis for fish consumption advisories The diagrams below illustrate how the levels of chemicals causing “zero consumption” fish advisories have changed over time. These changes in standards make it difficult to ensure adequate comparisons from the fish advisories prior to 2005.

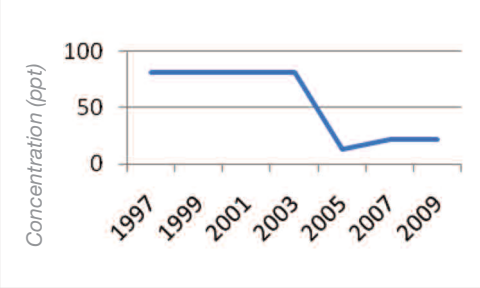
Comparisons are further complicated by the fact that the Ontario government does not release actual concentration levels found in the fish, only whether the levels have exceeded the ever-changing standards. On top of this, fish advisories do not always reflect up-to-date records of the actual concentrations found in fish. From year to year, not all fish from every size are caught at each location and the Ministry of the Environment commonly uses data from previous years to fill in the blanks. In such cases, comparing the data influencing fish advisories from different years may indicate no change when in fact contamination levels may have fluctuated.

This study focuses on a comparison between three years, 2005, 2007, and 2009, since standards did not change significantly during this time. In the case of dioxins and furans, the standard slightly increased the acceptable amounts of contamination, while the standard for PCBs was lowered moderately.

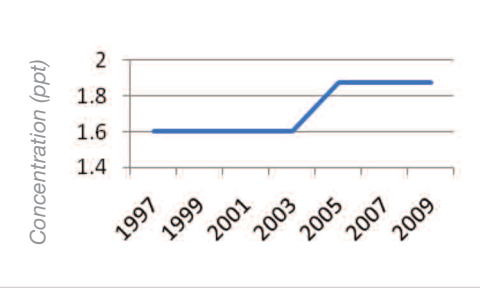
Mercury



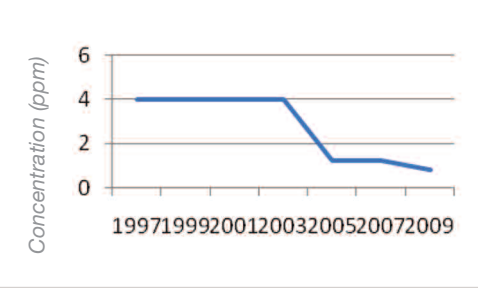
Dioxins and Furans



Toxaphene

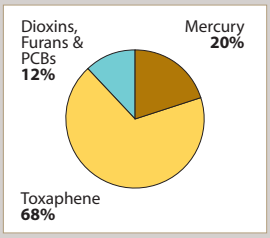


PCBs

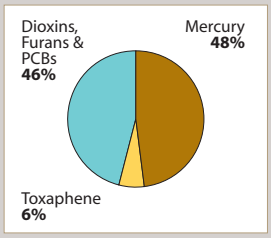


Consumption-limiting contaminants in the Great Lakes, 1999-2009:

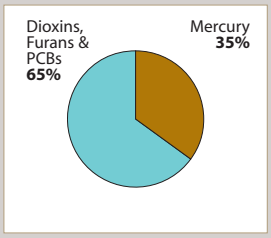
Lake Superior, 1999



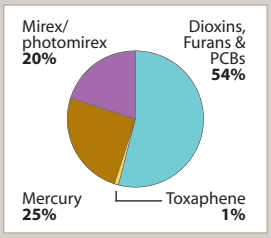
Lake Huron, 1999



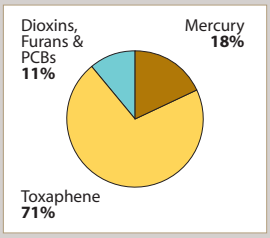
Lake Erie, 1999



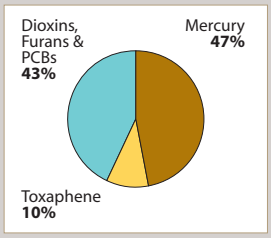
Lake Ontario, 1999



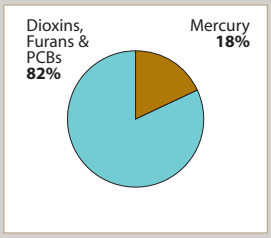
Lake Superior, 2003



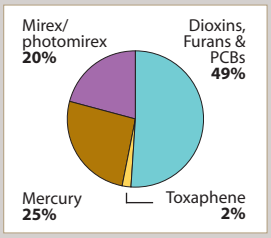
Lake Huron, 2003



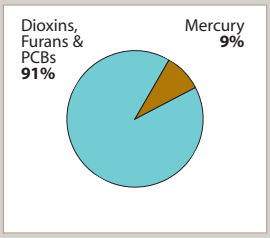
Lake Erie, 2003



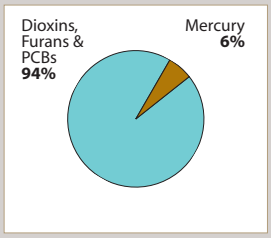
Lake Ontario, 2003



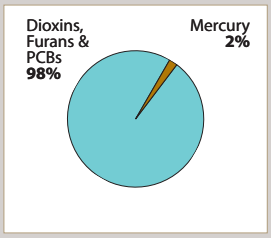
Lake Superior, 2007



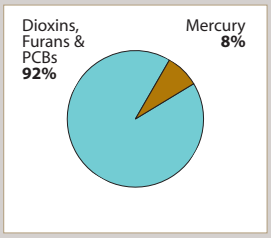
Lake Huron, 2007



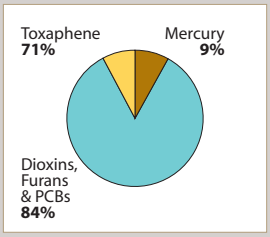
Lake Erie, 2007



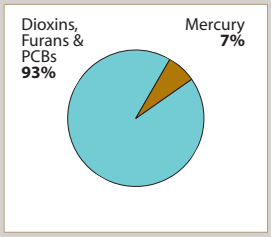
Lake Ontario, 2007



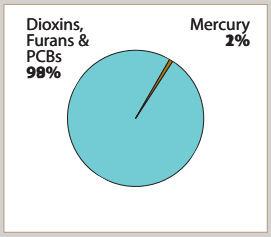
Lake Superior, 2009



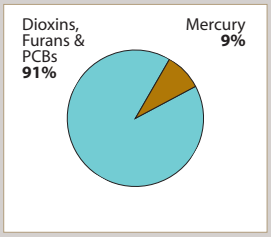
Lake Huron, 2009



Lake Erie, 2009



Lake Ontario, 2009



As these graphs illustrate, dioxins, furans and PCBs have outstripped all other consumption-limiting contaminants as a cause of fish advisories in each of the lakes.

Shifts in which contaminants cause advisories have taken place over time for a number of reasons, including changes to the concentration of chemicals considered toxic, and restrictions on their use and disposal. However, the apparent reduction of a consumption-limiting contaminant is not necessarily a sign of a decrease in the concentration of the contaminant within the fish themselves. It may merely reflect the rise of another contaminant as the primary cause of the advisory.

Possible explanations for the changes in contaminants causing fish advisories include: the elimination of toxaphene, mirex and photomirex from general use in both Canada and the United States; an increase in the allowable concentration of mercury; and the recent decrease in the allowable amount of PCBs.

CONCLUSION AND RECOMMENDATIONS

While health and nutrition experts rightly champion fish as a source of protein in a healthy and balanced diet, federal and provincial governments are compelled to caution consumers about the health risks of eating fish from Ontario lakes, rivers, and other bodies of water. The 2009-2010 *Guide to Eating Ontario Sports Fish* provides an adequate reference for anglers and others who eat sports fish from the Great Lakes, but much more information and advice is necessary to present an accurate account of contamination levels in Great Lakes fish and the potential risks to human health and the environment.

Examining fish advisories over time can illuminate changes in pollution inputs, risk to environmental and human health, and the overall integrity of the Great Lakes" to "Examining fish advisories over time can illuminate risks to human and environmental health, and thereby help protect the overall integrity of the Great Lakes."

For example, the data presented on the map and in the fish advisory statistics indicate that Lake Ontario has more severe consumption restrictions than those of the other Great Lakes, whereas Lake Huron has made the most progress in the past two years. However, the majority of fish advisories have not improved since the previous edition of the *Guide*.

The trends in fish consumption advisories clearly indicate that historic and ongoing pollution threatens the overall vitality of the Great Lakes ecosystem. To limit the risks to public health and the environment, steps should be taken to significantly reduce pollution emissions in the Great Lakes basin.

This is not to diminish the progress that is in fact being made in some parts of the Great Lakes. Especially in Lake Huron and Georgian Bay, some species are becoming less of a health threat, and fish that were unfit for consumption at certain sizes are edible once again. However, in many more regions of the Great Lakes, the opposite is true; fish advisories are getting more severe or remaining unacceptably high. For example, "zero consumption" advisories increased in Lake Erie and Lake Ontario from 2005-2009.

The format of the *Guide to Eating Ontario Sports Fish*, while efficient for displaying basic information relating to how many Great Lakes fish should be consumed on a monthly basis, fails to provide important information about the actual levels of contaminants in the fish, or indicate the historical levels of contamination. While this data no doubt exists, it is not publicly accessible in a user-friendly form, and the data provided is often out-of-date or incomplete.

RECOMMENDATION 1: ***Provincial, state and national partners in the U.S. and Canada must develop and maintain a publicly accessible record of information on the current status, evolution and historical levels of chemical contamination of fish in the Great Lakes, including information on the toxicity levels of fish in and around the Great Lakes basin and in contaminated sediment.***

Such a record would provide the public with detailed information on fish contamination and with the means to make assessments of Great Lakes health based on levels of contamination in fish, toxic chemical releases in and around the Great Lakes, and levels of contaminants found in sediment. This information can in turn be used to make informed judgments on how to protect and clean up the Great Lakes.

While Ontario fish advisories do take into account the special health concerns and impacts of contaminants on women of child bearing age and children, they do not address the needs of other populations that are at risk. These populations may include those who are most vulnerable to the effects of exposure, those that already have high toxic levels from eating fish from the Great Lakes or elsewhere, or populations living near industrial facilities emitting high levels of these contaminants that increase exposure through other pathways.

RECOMMENDATION 2: ***In an effort to address local circumstances, the various sources of fish in the average diet and the diversity among local consumers, a program for monitoring local fish consumption and the use of advisories should be used to develop a comprehensive approach to fish advisories targeted at specific at-risk populations.***

While this report does not address the actual levels of contaminants found in fish in the Great Lakes, continued restrictive fish consumption advisories suggest that pollution is entering the food chain at disturbing levels. The major consumption-limiting contaminants – mercury, dioxins, furans and PCBs – are all on Binational Toxics Strategy virtual elimination list, yet both mercury and dioxins and furans are released by facilities in Ontario and the Great Lakes states. While steps have been taken to limit these chemicals, these plans suffer from a lack of comprehensiveness and effective timelines.

RECOMMENDATION 3: ***Stringent timelines must be set for reducing chemicals on the Canada-US Binational Toxics Strategy lists, particularly for mercury, PCBs, and dioxins and furans.***

The precautionary principle requires that action be taken to reduce dangerous risks in the absence of full scientific certainty about toxic substances. It should also apply to chemicals of emerging concern, including endocrine disruptors and PBDEs. Recent scientific reports have identified harmful hormone disrupting chemicals that threaten the Great Lakes, with worrisome implications for wildlife in those systems.[15] For example, PBDE levels in Lake Ontario Lake Trout increased by 315% from 1978 to 1998.[16] While the Ontario Ministry of the Environment is developing methods of analyzing and testing new and emerging chemicals, the process is slow and the cumulative effects of these chemicals remain unknown.

RECOMMENDATION 4: ***New reduction targets for chemicals of emerging concern must be adopted through the Binational Toxics Strategy, taking into account: a) the direct health effects of prolonged exposure, b) bioaccumulation in ecosystems, and c) the cumulative effects that these chemicals have in the natural environment and on human health.***

These targets should be adopted over the span of two to three years, providing a reasonable timeframe for the research necessary to determine appropriate levels and concentrations.

Industrial and commercial activities are not the only contributors of contaminants to the Great Lakes system. As noted by Ecojustice in the latest edition of their sewage report card for the Great Lakes,[17] municipal sewer systems have enormous environmental, economic, and human health impacts. Sewage effluent released in Ontario in 2006 contained 14,415 tonnes of lead, 241.5 tonnes of chlorine, and 236 kg of mercury.[18] The bulk of Ontario's sewage effluent is released into the Great Lakes.[19]

RECOMMENDATION 5: ***The federal government must adopt new nationally enforceable standards for sewage treatment, including strong provisions for dealing with toxic substances in the sewage treatment process. Ontario should also include sewage treatment plants in its Toxics Reduction Act, requiring them to produce pollution prevention plans.***

A major source of chemical contamination in the Great Lakes is the combined contributions made by a range of day-to-day activities, including agriculture practices, runoff over urban areas and emissions from transportation.

RECOMMENDATION 6: ***Integrated watershed management must be implemented to ensure that pollution from agriculture, urban development and other non-point sources must be addressed through programs to reduce their impact on the Great Lakes, including an ecosystem-based land-use decision making process that protects remaining healthy fish habitats.***

In addition to the environmental and health implications of Great Lakes fish contamination, there are serious economic effects. While the Great Lakes Fishery Commission exists to facilitate cooperation between the United States and Canada for the protection of the Great Lakes fisheries resource, it does not have the financial resources to adequately address the threats posed by pollution.

RECOMMENDATION 7: ***The Great Lakes Fishery Commission must be given the resources to conduct studies and put forward recommendations for restoring the health of the Great Lakes ecosystem to protect fish from chemical contamination.***

Chemical contamination of the Great Lakes imposes a substantial economic cost. The Ontario government is forced to spend millions on contaminant testing and publishing the Guide. More broadly, chemical contamination negatively affects both the commercial and recreational fisheries, whose combined value—added economies are worth an estimated $2.45 billion in Ontario.[20, 21] About $33 million has been spent cleaning up contaminated sediments from Canadian Areas of Concern (AOCs),[22] and $160 million from U.S. AOCs. Ordinary citizens should not have to foot this enormous bill.

RECOMMENDATION 8: ***The "Polluter Pays Principle" – whereby the parties responsible for the damage done to the environment are also held responsible for paying for that damage – should be applied across the Great Lakes basin.***

On both the Canadian and American sides, large polluters like coal power plants, cement kilns, and petrochemical plants should be taxed in order to fund future remediation and research efforts for the Great Lakes. Taxation would be based on their output of the pollutants covered by the Binational Toxics Strategy.

SUMMARY OF RECOMMENDATIONS:

RECOMMENDATION 1: Provincial, state and national partners in the U.S. and Canada must develop and maintain a publicly accessible record of information on the current status, evolution and historical levels of chemical contamination of fish in the Great Lakes, including information on the toxicity levels of fish in and around the Great Lakes basin and in contaminated sediment.

RECOMMENDATION 2: In an effort to address local circumstances, the various sources of fish in the average diet and the diversity among local consumers, a program for monitoring local fish consumption and the use of advisories should be used to develop a comprehensive approach to fish advisories targeted at specific at-risk populations.

RECOMMENDATION 3: Stringent timelines must be set for reducing chemicals on the Canada-US Binational Toxics Strategy lists, particularly for mercury, PCBs, and dioxins and furans.

RECOMMENDATION 4: New reduction targets for chemicals of emerging concern must be adopted through the Binational Toxics Strategy, taking into account: a) the direct health effects of prolonged exposure, b) bioaccumulation in ecosystems, and c) the cumulative effects that these chemicals have in the natural environment and on human health.

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ACKNOWLEDGEMENTS

This report was prepared by Environmental Defence. Information in this report is based on fish advisory data provided in the *Guide to Eating Ontario Sport Fish* prepared by the Ontario Ministry of the Environment and is available at www.ontario.ca/fishguide.

Environmental Defence would like to thank the Mott Foundation whose generous support made possible the production of this report. We would also like to thank Dr. Gail Krantzberg from McMaster University, the Ontario Ministry of the Environment Sport Fish Contaminant Monitoring Program and others for their thoughtful input and guidance.

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