



WATER

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USES

Second edition

# TOXIC CONTAMINATION IN FRESHWATER FISH

## Background

Since the turn of the 20th century, the Great Lakes and St. Lawrence River have been contaminated by hundreds of toxic substances used in industry or agriculture. Some of these substances accumulate in living organisms, including fish. Sport fishing is very popular in Quebec, with over 25% of the population engaging in this activity. Moreover, it is increasingly recommended that we should include fish in our diets due to its nutritional qualities and health benefits. A recent study carried out in

the Montreal region showed no dangerous levels of chemical contaminants in people who regularly eat fish caught in the St. Lawrence River.

The content of organic contaminants, such as organochlorine substances, and inorganic contaminants, such as metals, were measured in fish tissues and organs, with a focus on mercury and polychlorinated biphenyls (PCBs). Although mercury occurs naturally in the environment, various consumer goods, fossil fuels and industrial processes are major sources

of mercury. In its methylated form, mercury is harmful because it affects the nervous systems of living beings. PCBs belong to the family of organochlorines (DDT, dioxins, furans) and have many different applications. The production of



White Sucker

PCBs has been prohibited in North America since 1977. Organochlorines have a variety of toxic effects, including skin irritation, effects on the liver, immune system, nervous system and reproductive system, and cancer. They are also suspected of mimicking the action of hormones and of disrupting the endocrine system.

Mercury and PCBs are widespread in the environment. Mercury and PCB contamination of fish is a good indicator of the state of contamination of the environment.

## Overview of the Situation

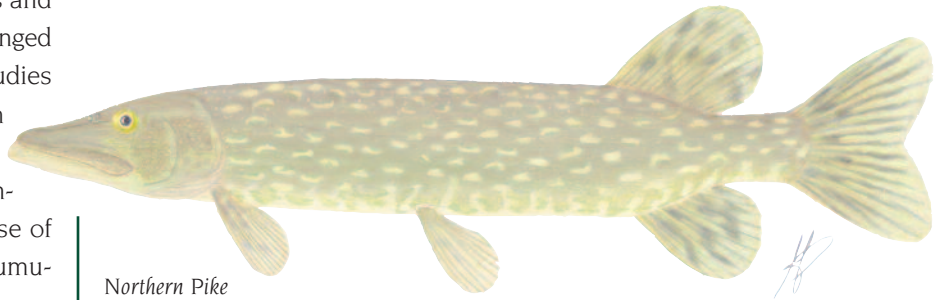
Data on fish contamination in the St. Lawrence River have been collected in studies since the 1970s. The data provide a relatively clear picture of toxic



Photo: Paul Grant. © Québec en images, CCDMD

contamination of a few fish species and of how such contamination has changed over time. Since the 1970s, the studies show that the level of contamination of fish in the St. Lawrence has declined, although chemical contaminants are still detected. In the case of mercury, the phenomena of bioaccumulation (accumulation of toxic substances in the tissues of living organisms) and biomagnification (increase in the levels of toxic substances in fish on the basis of their position in the food chain) result in higher contamination levels in older fish and piscivores (fish eaters), such as northern pike and walleye. Mercury accumulates primarily in fish tissues, whereas organochlorines are found in higher concentrations in fatty tissues and organs such as the liver and gonads.

The recent study of PCB and mercury levels and fluctuations in fish in lakes Saint-François, Saint-Louis and Saint-Pierre illustrated the state of contami-



Northern Pike

nation of the St. Lawrence River and how it has changed since the 1970s. Among the species studied are walleye, northern pike, piscivorous game fish and white sucker, which is prey for piscivorous species. White sucker feeds on benthic species and detritus. PCBs were analysed in whole white sucker, and mercury was analysed in the flesh of walleye and northern pike.

**Mercury**

The data show that overall, in walleye and northern pike, the average mercury levels were below the level given in

Health Canada’s commercial guideline (0.5 mg/kg) (Figure 1). However, average values exceeding the guideline were observed in Lake Saint-Louis (Îles de la Paix sector). Individual values exceeding



Photo: Denis Chabot, © Québec en images, CCDMD



Lake Saint-Louis — Îles de la Paix

Photo: Yvon Richard, MDDEP

the guideline were also observed more or less throughout the study area in the larger, and thus older, specimens. With the exception of carp caught at Gentilly and Atlantic Sturgeon caught near Île d'Orléans, average mercury concentrations for all species and at all sites exceed the Quebec guideline of 0.057 mg/kg for the protection of fish-eating terrestrial wildlife.

Mercury levels in fish have dropped relative to 1976 values, except for the northern pike in Lake Saint-Louis (Figure 2). The data show that efforts to reduce environmental mercury contamination have resulted in significant declines in mercury concentrations in fish communities. However, it appears that there were active sources of mercury in Lake Saint-Louis between 1976 and 2005, in the area of the Îles de la Paix. In 2006, mercury-contaminated sediments were removed near the outlet of the Saint-Louis River. This corrective action should reduce the mercury levels in fish. Thus, despite the downward trend, fish contamination continues to be a concern in Lake Saint-Louis. In this sector, concentrations exceeding the Canada Health standards for marketing fishery products were observed.

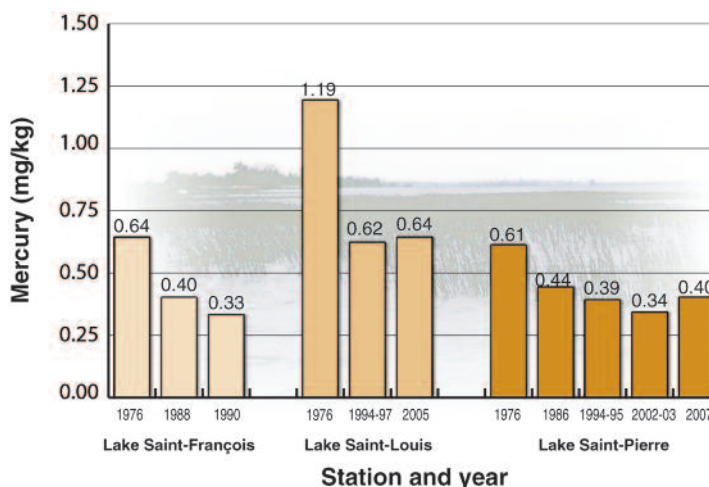
**PCBs**

In the St. Lawrence River, average PCB concentrations in fish tissue samples taken from different species and size classes of fish are generally well below Health Canada's guideline of 2000 µg/kg for BPC content in commercial fish. However, concentrations observed since 2004 in whole white suckers generally slightly exceed the guideline for the protection of terrestrial piscivores (160 µg/kg). These concentrations likely pose a low risk to fish-eating terrestrial wildlife.

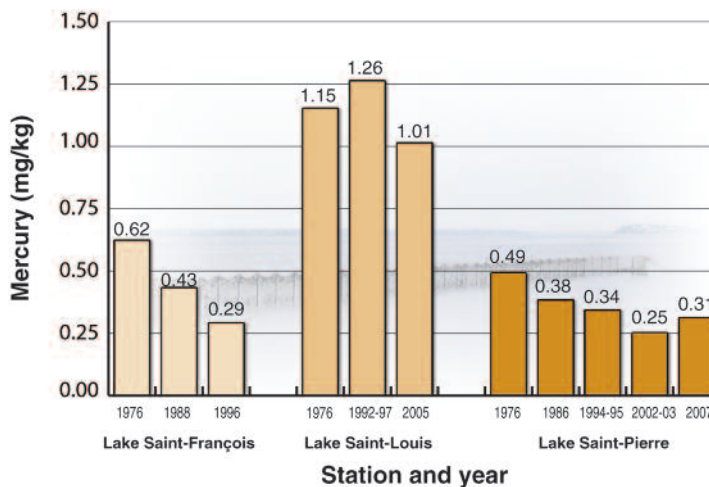


Photo: Yvon Richard, MDDEP

**Figure 1. Average mercury concentration in walleye tissue samples between 1976 and 2007 in lakes Saint-François, Saint-Louis and Saint-Pierre**



**Figure 2. Average mercury concentration in northern pike tissue samples between 1976 and 2007 in lakes Saint-François, Saint-Louis and Saint-Pierre**



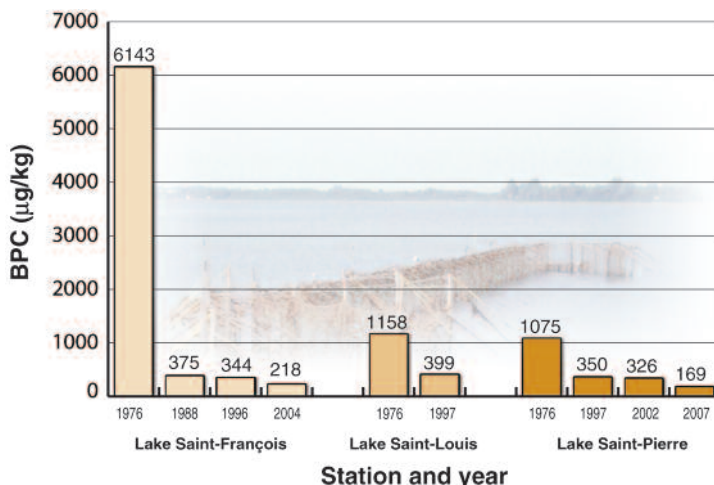
Nonetheless, considerable reductions in PCB levels in White Suckers have been observed in the three lakes since 1976 (Figure 3). These reductions show that the ban on PCB and the PCB recovery and destruction efforts have been effective in significantly reducing contamination levels in the St. Lawrence.

Another study was conducted from 1994 to 1996 on the contamination of fish caught at a reference site near Quebec City, in Saint-Nicolas. Located at the mouth of the fluvial system, this site has the advantage of integrating all contamination from upstream. Once again, the results at this site show that contaminant concentrations (trace metals, PCBs, chlorobenzenes, organochlorine pesticides) in fish tissue are low and are generally well below the guidelines for consumption. However, much higher concentrations are found in organs like the liver (Figure 4).

### Outlook

Various contaminants are detected in fish from the St. Lawrence. Only mercury, however, is present at concentrations that occasionally exceed the guideline for consumption, particularly in older specimens. The current contamination level must therefore not be ignored. On the whole, however, concentrations are generally down and the data show that there is not a high level of bioconcentration of contaminants in fish tissues. In addition, the contamination trend has clearly been on the decline since the 1970s, particularly for mercury and PCBs. The consumption of fish from the St. Lawrence poses no risk, provided the recommendations of the Quebec departments of Sustainable Development, Environment and Parks, and Health and

**Figure 3. Average PCB concentration in whole white suckers between 1976 and 2007 in lakes Saint-François, Saint-Louis and Saint-Pierre**



**Figure 4. Average PCB concentration in the tissues and liver of five species of fish caught at Saint-Nicolas between 1994 and 1996**

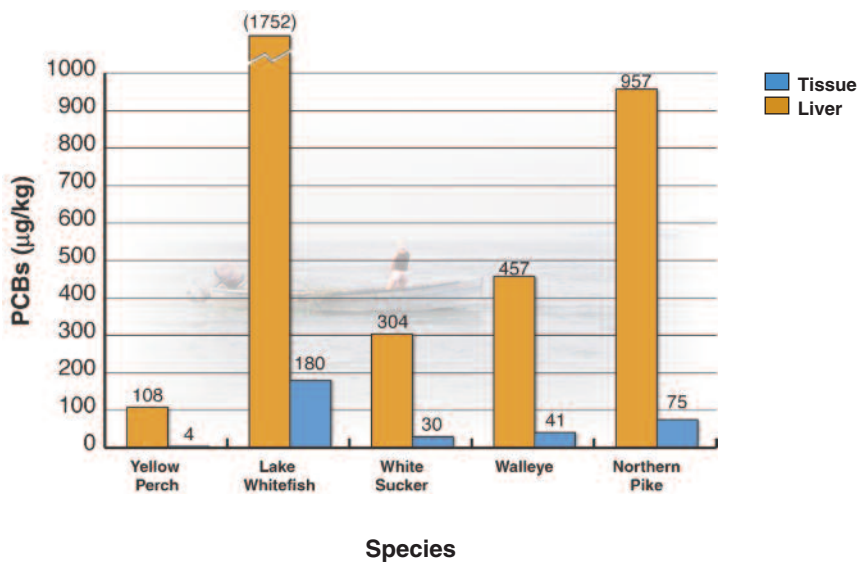




Photo: Yvon Richard, MDDEP

Eel fishing in Portneuf

## KEY VARIABLES

Health Canada's administrative guidelines for the commercial sale of fish products are intended to protect the health of consumers of fish. The allowable concentration is 0.5 mg per kilogram of tissue for mercury and 2000 µg/kg of tissue for PCBs. Other reference values are the guidelines for the protection of terrestrial piscivores, which are aimed at fish-eating mammals and birds. The allowable concentrations are 0.057 mg/kg of tissue for mercury and 160 µg/kg of tissue for PCBs. The concentrations recommended for the protection of wildlife are lower than those for the protection of human health, because fish consumption make up a large part of the diet of wildlife species, but only a small part of the normal human diet.

Social Services are adopted. To that end, and for many years, the two departments have jointly published guidelines for the consumption of freshwater fish: [www.mddep.gouv.qc.ca/eau/guide/index.htm](http://www.mddep.gouv.qc.ca/eau/guide/index.htm).

Through tighter regulations and a number of government programs, it has been possible to significantly reduce contaminant releases into the St. Lawrence River. Upstream, in the Great Lakes, considerable efforts have also been made to reduce toxic releases and to clean up contaminated sites. Other programs are contributing to reducing toxic loadings. For example, under the Mercury Action Plan of the Conference of New England Governors and Eastern Canadian Premiers, adopted in 1998, it should be possible to significantly reduce anthropogenic mercury releases in eastern North America. The issue of

toxic contaminants is still a concern, but it is likely that the downward trend in toxic substances in the environment and fish communities can be maintained. However, it is important to bear in mind that contaminants from distant sources can reach the St. Lawrence basin by atmospheric transport.

The current level of toxic contamination is low enough that the public can resume their traditional uses of the St. Lawrence — that is, catching and eating fish from the river. However, such uses will have to remain at moderate levels, given the presence of low concentrations of various chemical contaminants in fish tissues. The contaminants will likely be present, but in declining quantities, in the water, sediments and biological communities of the St. Lawrence for decades to come. However, the available



Photo: Yvon Richard, MDDEP

Lake Saint-Pierre archipelago



Photo: Yvon Richard, MDDEP

Eel fishing in Portneuf

data show that their presence does not preclude eating fish from the river at this time. It is then possible to derive health benefits from doing so, given the recognized nutritional value of fish.

### To Know More

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## State of the St. Lawrence Monitoring Program

Six government partners — Environment Canada, the Ministère du Développement durable, de l'Environnement et des Parcs du Québec, Fisheries and Oceans Canada, the Ministère des Ressources naturelles et de la Faune du Québec, the Canadian Space Agency, and Parcs Canada Agency — and Stratégies Saint-Laurent are

pooling their expertise and efforts to provide Canadians, on a regular basis, with information on the state of the St. Lawrence and long-term trends affecting it. The fact sheets and additional information about the program are also available on the Web site: [www.planstlaurent.qc.ca](http://www.planstlaurent.qc.ca)

You can also contact the St. Lawrence Plan Coordination Office:

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