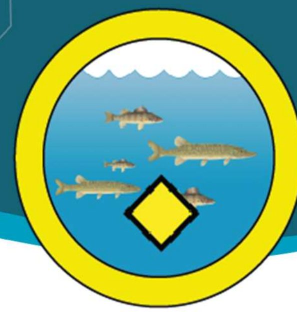
Monitoring the State of the
ST. LAWRENCE RIVER

Toxic contamination of freshwater fish – 5th edition



Status: Moderate
Trend: Deteriorating since 2016 for mercury; unchanged for PCBs, penta-BDEs, and dioxins and furans; unknown for PFOS.

Highlights

Between 2019 and 2024, for the species and sizes studied, mercury levels in fish tissues occasionally exceeded Health Canada's guidelines,[1] while levels of perfluorooctane sulfonate (PFOS) frequently exceeded the criteria for the protection of fish-eating terrestrial wildlife established by the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP).[2] Levels of other toxic substances remained below the criteria and reference values for human consumption.

Issue

This indicator shows the level of contamination by mercury, polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), dioxins and furans, and perfluoroalkyl substances (PFAS) in the tissues of walleye, northern pike, yellow perch and whole white sucker in Lake Saint-François, Lake Saint-Louis and Lake Saint-Pierre from 2014 to 2024 (Figure 1). Fish sampling is conducted every three to five years as part of the Réseau de suivi ichtyologique (RSI) [fish monitoring network]. The indicator helps provide recommendations on sport fish consumption[3] and assess the risks posed to fish-eating wildlife by these bioaccumulative and environmentally persistent toxic substances.

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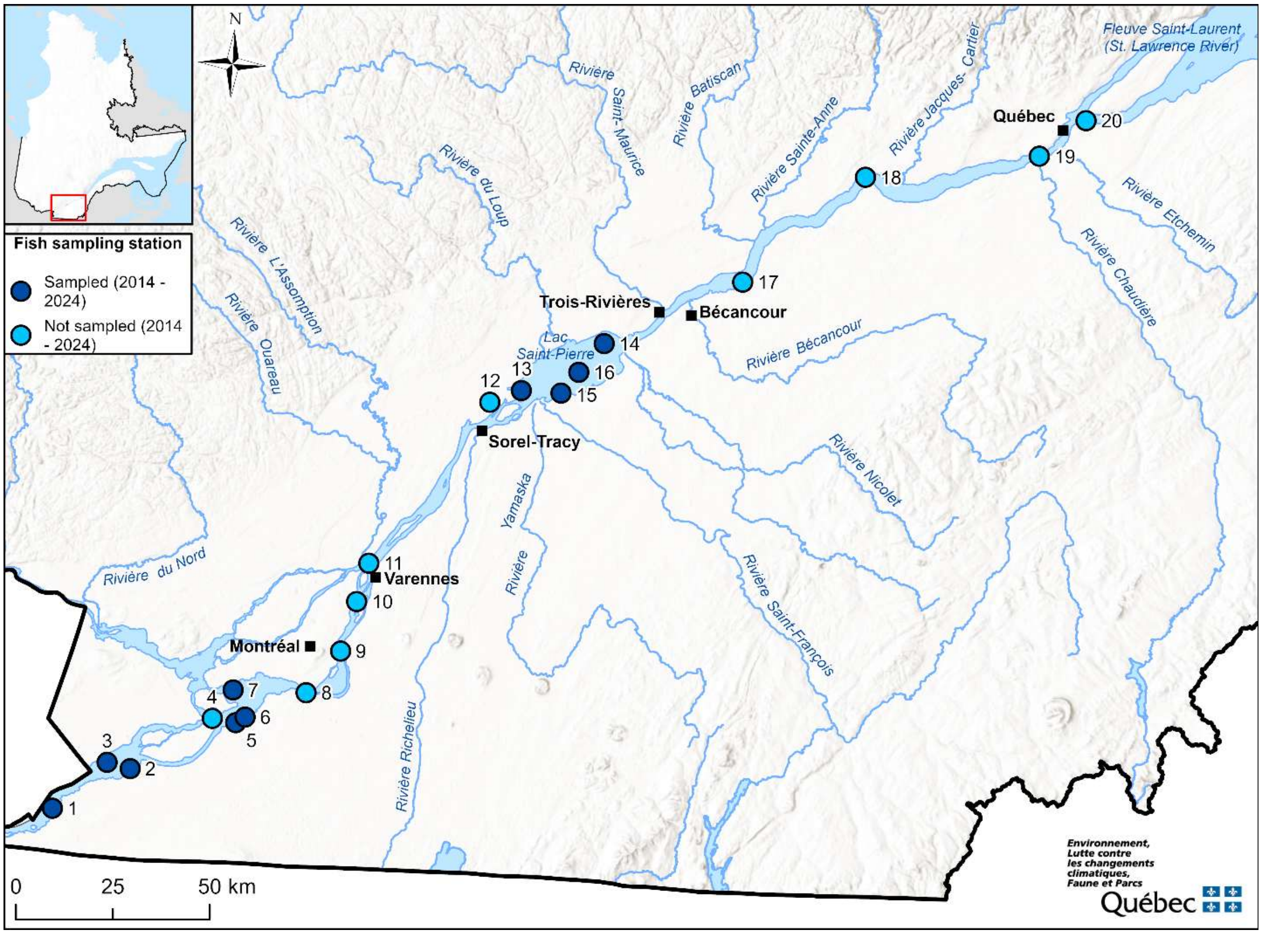

Figure 1: Fish sampling stations in the St. Lawrence River

KEY SOURCES OF CONTAMINATION

Mercury

Mercury occurs naturally in rock, air and water and is also released into the environment by industrial sources. It is released into the environment through a wide range of consumer products and, in particular, via the burning of petroleum, oil and coal.[3,4]

PCBs

PCBs are a class of organic chemicals with multiple historical uses. These compounds have been banned in Canada since 1980, and their presence is solely due to human activity. PCBs were used in hydraulic and electrical equipment.[3,5]

PBDEs

PBDEs have been added to various plastic matrices, synthetic resins and textile fibres to reduce the flammability of a range of consumer products, furniture upholstery, electronics casings and automotive parts, among others. The use of PBDEs was gradually phased out between 2006 and 2012.[3,6]

Dioxins and furans

Dioxins and furans are formed in very small quantities as impurities during the production of certain pesticides or during chlorine bleaching in pulp and paper mills. They are also formed during the incineration of certain municipal and industrial waste and in fires involving electrical equipment containing chlorinated organics. Additionally, dioxins can result from natural causes, such as forest fires and volcanic eruptions.[3,7]

PFAS

PFAS are used as stain-resistant, non-stick and waterproofing agents, as well as for their flame-resistant properties.[3,8]

In Canada, the federal government has introduced regulations prohibiting the manufacture, use, sale and import of certain PFAS, such as PFOS, perfluorooctanoic acid (PFOA) and long-chain perfluorocarboxylic acids (PFCAs), as well as products containing them.

FACTORS AFFECTING LEVELS OF CONTAMINATION IN FISH

Mercury

Mercury accumulates in fish, shellfish and other edible freshwater organisms in a form that is potentially harmful to humans. The degree of contamination in fish varies depending on the species, age and location of capture. Fish-eating species—that is, those that feed on other fish, such as bass, pike, walleye and muskellunge—have the highest levels of contamination. Within the same species, larger specimens generally contain higher concentrations of mercury than smaller specimens.[3]

PCBs, PBDEs, and dioxins and furans

PCBs, PBDEs, and dioxins and furans nearly always enter water bodies, where they largely bind to fine particles that remain suspended or settle to the bottom. They then enter aquatic organisms through the consumption of contaminated water or food, accumulating in fatty tissues.

Concentrations of these substances in fish depend on diet and tissue fat content. In lean fish, such as walleye, northern pike or yellow perch, these substances accumulate primarily in the liver or adipose tissue, whereas the white sucker, when analyzed whole with viscera, contains more fat and exhibits higher concentrations of contaminants than lean fish. In general, these contaminants accumulate in the viscera, fat and skin.[3]

PFAS

In general, PFAS are extremely persistent in the environment, as fluorocarbon groups (primarily $-CF_2-$) are highly stable and resistant to biodegradation, hydrolysis, photolysis and thermolysis. PFAS generally exhibit a combination of oleophobic, hydrophobic and hydrophilic properties across different parts of their chemical structure. It is important to note that, rather than accumulating in lipids, like PBDEs and organochlorines, some of these substances preferentially bind to proteins and are therefore found in protein-rich tissues, such as the flesh, liver and blood. For whole white sucker, a homogenate of all of these tissues is analyzed, instead of using flesh-only analysis.[8]

Key measurements

Categories for assessing contamination in fish flesh:

Good: All concentrations measured in fish flesh are below the reference values for human consumption or do not exceed them by more than 10% – not of concern.

Moderate: Concentrations measured in fish flesh are near the reference values for human consumption, but one species may exceed these values locally by more than 10% – monitoring is needed.

Poor: Several species have flesh concentrations exceeding the reference values for human consumption by more than 10%, or a single species exhibits concentrations exceeding these values throughout the entire fluvial corridor – of concern.

Status and trends

Mercury

Over the 2019–2024 period, average mercury concentrations were below Health Canada's guideline of 0.5 mg/kg[1] for the sale of walleye, with the exception of levels on the north shore of Lake Saint-Louis in 2019, and for yellow perch and white sucker. However, northern pike had an average mercury concentration exceeding this guideline on the north shore of Lake Saint-François in 2022 (0.59 mg/kg) and the south shore of Lake Saint-Louis in 2024 (0.58 mg/kg), as well as on the north shore of Lake Saint-Pierre in 2021 (0.69 mg/kg) and the south shore of Lake Saint-Pierre in 2019 (0.54 mg/kg) and 2021 (0.53 mg/kg) (Figure 2).

AN UPWARD TREND FOR MERCURY

When comparing the average mercury concentrations measured during the 2019–2024 period with those of the 2014–2016 period measured in walleye (425 mm), northern pike (600 mm), yellow perch (215 mm) and white sucker (425 mm), the following trends were observed:

- **Lake Saint-François**: On the south shore in 2022, walleye (0.31 mg/kg) showed a significant increase of 41% in average mercury concentrations. On the north shore in 2022, yellow perch (0.31 mg/kg) and whole white sucker (0.26 mg/kg) showed significant increases of 24% and 86%, respectively, in average mercury concentrations compared with 2014.
- **Lake Saint-Louis**: On the south shore in 2024, northern pike (0.58 mg/kg) and yellow perch (0.30 mg/kg) showed significant decreases of 28% and 25%, respectively, in mercury concentrations compared with 2016.
- **Lake Saint-Pierre**: On the south shore in 2021, walleye (0.50 mg/kg), northern pike (0.53 mg/kg), yellow perch (0.23 mg/kg) and whole white sucker (0.21 mg/kg) showed significant increases of 35%, 56%, 21% and 62%, respectively, in mercury concentrations compared with 2016. On the north shore in 2021, walleye (0.47 mg/kg), northern pike (0.69 mg/kg), yellow perch (0.27 mg/kg) and whole white sucker (0.20 mg/kg) also showed significant increases of 42%, 57%, 17% and 54%, respectively, in mercury concentrations compared with 2016.

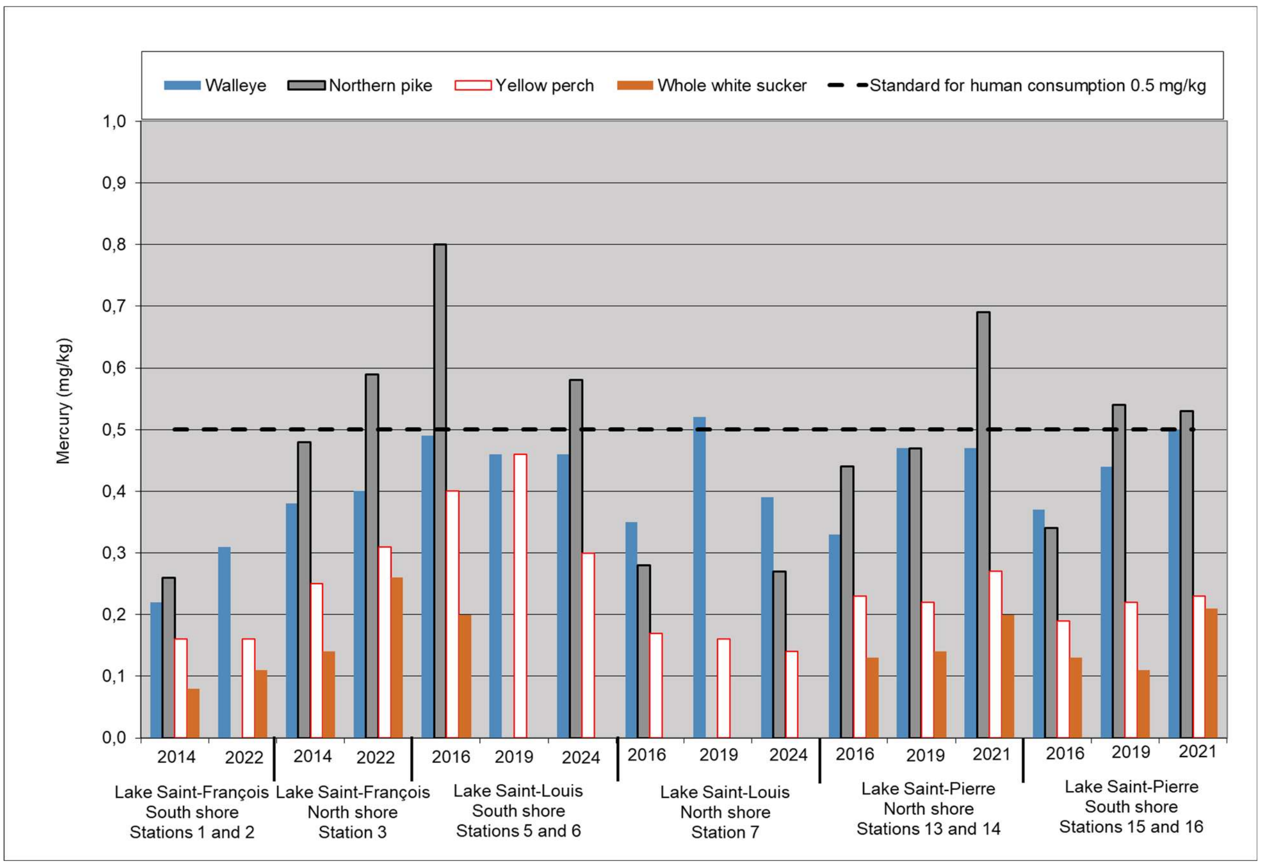

Figure 2: Trends in average mercury concentrations in the flesh of walleye (425 mm), northern pike (600 mm), yellow perch (215 mm) and white sucker (425 mm) in the St. Lawrence River for the 2014–2024 period.

Polychlorinated biphenyls (PCBs)

Average PCB concentrations measured in fish flesh from 2019 to 2024 were all below the European Union standard of 125 µg/kg.[9] In addition, for whole white sucker, the average PCB concentrations were all below the MELCCFP[2] protection criterion of 160 µg/kg for fish-eating terrestrial wildlife, with the exception of the north shore of Lake Saint-Pierre in 2021, which slightly exceeds the criterion (Figure 3).

Average PCB concentrations in fish flesh show few differences across the studied areas, with the exception of walleye on the north (60 µg/kg) and south (93 µg/kg) shores of Lake Saint-François in 2022 and whole white sucker on the north shore (176 µg/kg) of Lake Saint-Pierre in 2021 (Figure 3).

The average PCB concentrations measured during the 2019–2024 period remain relatively comparable to those of the 2014–2016 period, with the exception of the average concentrations in walleye captured on the south shore of Lake Saint-François in 2022 (93 µg/kg) when compared with the value for 2014 (49 µg/kg).

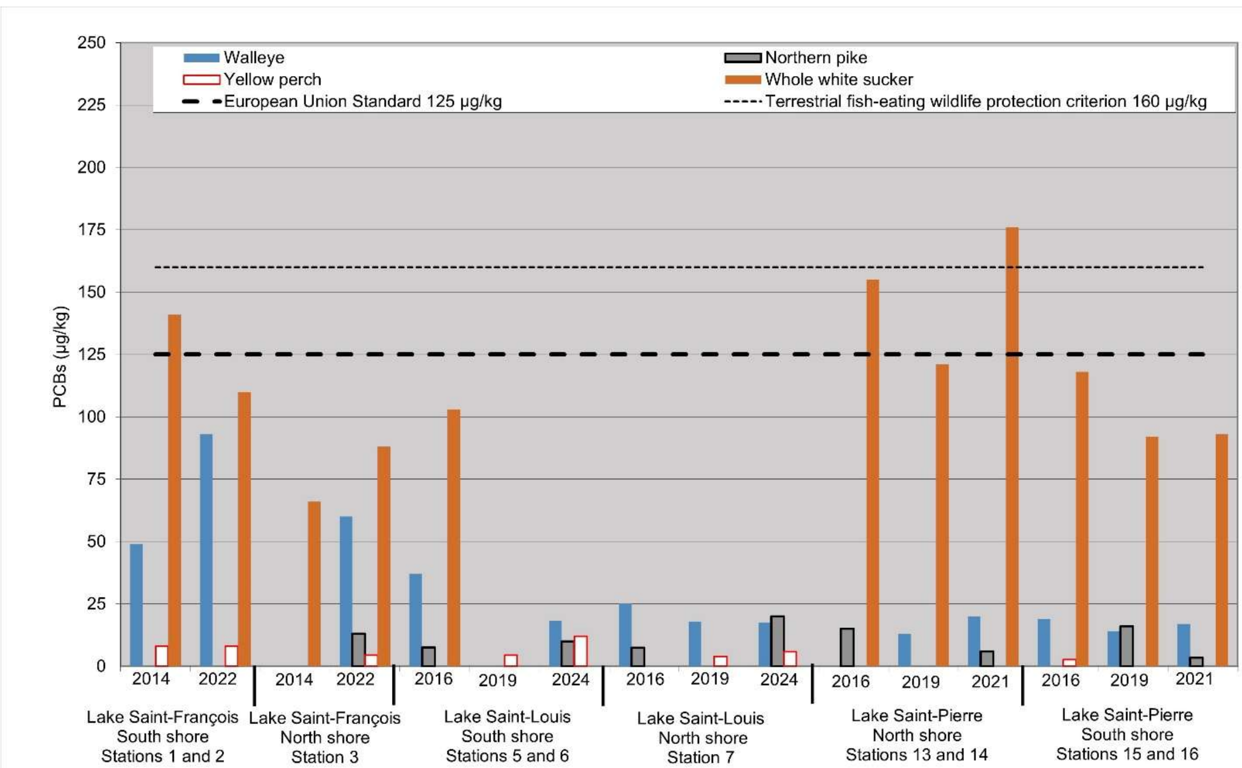

Figure 3: Trends in average PCB concentrations in the flesh of walleye, northern pike, yellow perch and whole white sucker in the St. Lawrence River for the 2014–2024 period.

Polybrominated diphenyl ethers (PBDEs)

There is no reference value for the amount of PBDEs in fish flesh that is considered acceptable for human consumption. From 2019 to 2024, the average concentrations for the three main congener groups normally detected in fish (tetra-BDEs, penta-BDEs and hexa-BDEs) were all below the respective criteria of 44 µg/kg, 3 µg/kg and 4 µg/kg.[2,10]

The average concentrations of total PBDEs in fish flesh show little variation across the studied areas. However, in whole white sucker from the north (20.8 µg/kg) and south (11.2 µg/kg) shores of Lake Saint-Pierre in 2021, these levels were relatively lower than those observed in 2016 (Figure 4).

In contrast, the average concentrations of total PBDEs measured during the 2019–2024 period show a downward trend compared with the 2014–2016 period, particularly in whole white sucker on the north shore of Lake Saint-Pierre in 2021 (20.8 µg/kg) relative to 2016 (27.7 µg/kg), and on the south shore in 2021 (11.2 µg/kg) relative to 2016 (22 µg/kg).

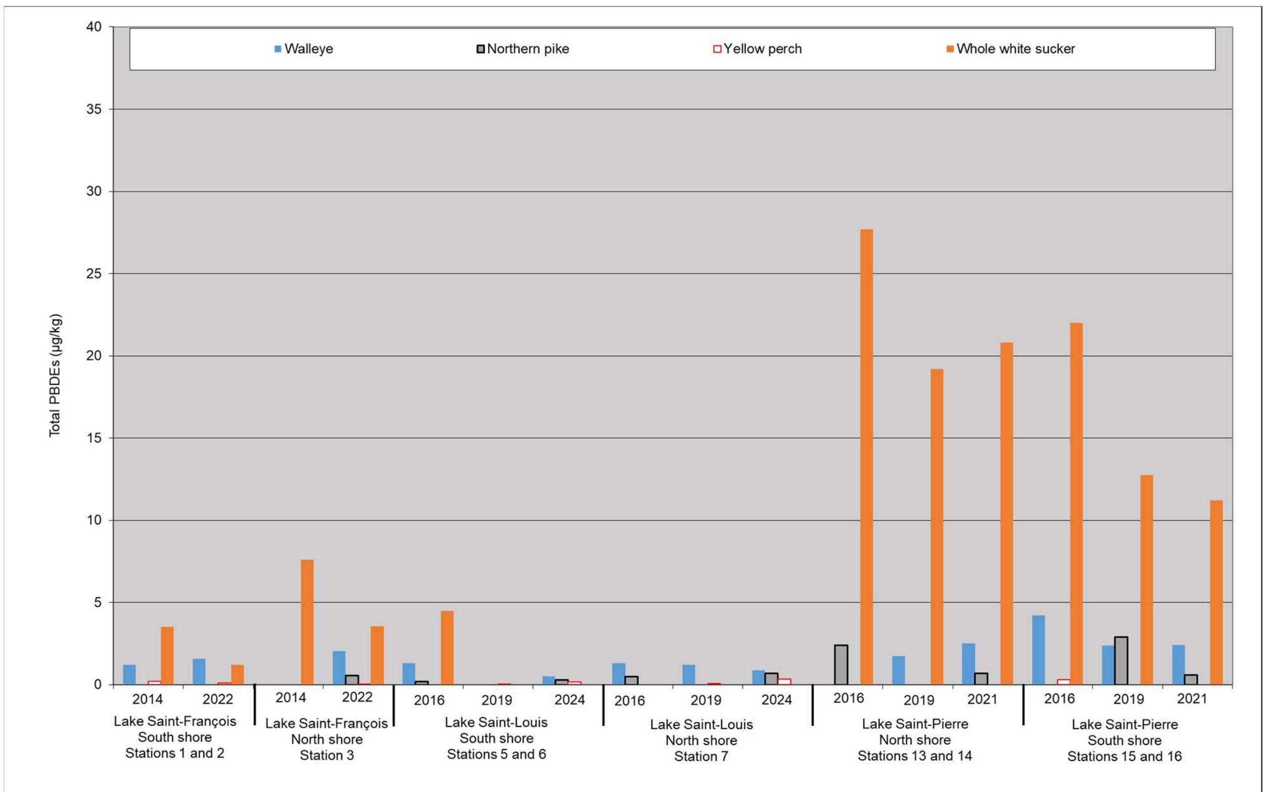

Figure 4: Trends in average total PBDE concentrations in the flesh of walleye, northern pike, yellow perch and whole white sucker in the St. Lawrence River for the 2014–2024 period.

Dioxins and furans

During the 2019–2024 period, the average concentrations of dioxins and furans in fish flesh, expressed as 2,3,7,8-TCDD toxic equivalents, remained below the European Union standard of 3.5 ng/kg[9] in all species across all areas. Values ranged from 0 to 0.044 ng/kg, except for an average value of 0.28 ng/kg in walleye on the north shore of Lake Saint-François (Figure 5).

During the 2019–2024 period, the average concentrations of 2,3,7,8-TCDD toxic equivalents in whole white sucker were all below the 0.66 ng/kg[2] criterion for the protection of fish-eating terrestrial wildlife, except on the north shore of Lake Saint-Pierre in 2021, where a concentration of 0.716 ng/kg was measured. The highest values were measured in whole white sucker on the north shore of Lake Saint-Pierre in 2019 and 2021 (0.525 ng/kg and 0.716 ng/kg) and on the north and south shores of Lake Saint-François in 2022 (0.5 ng/kg and 0.4 ng/kg; Figure 5).

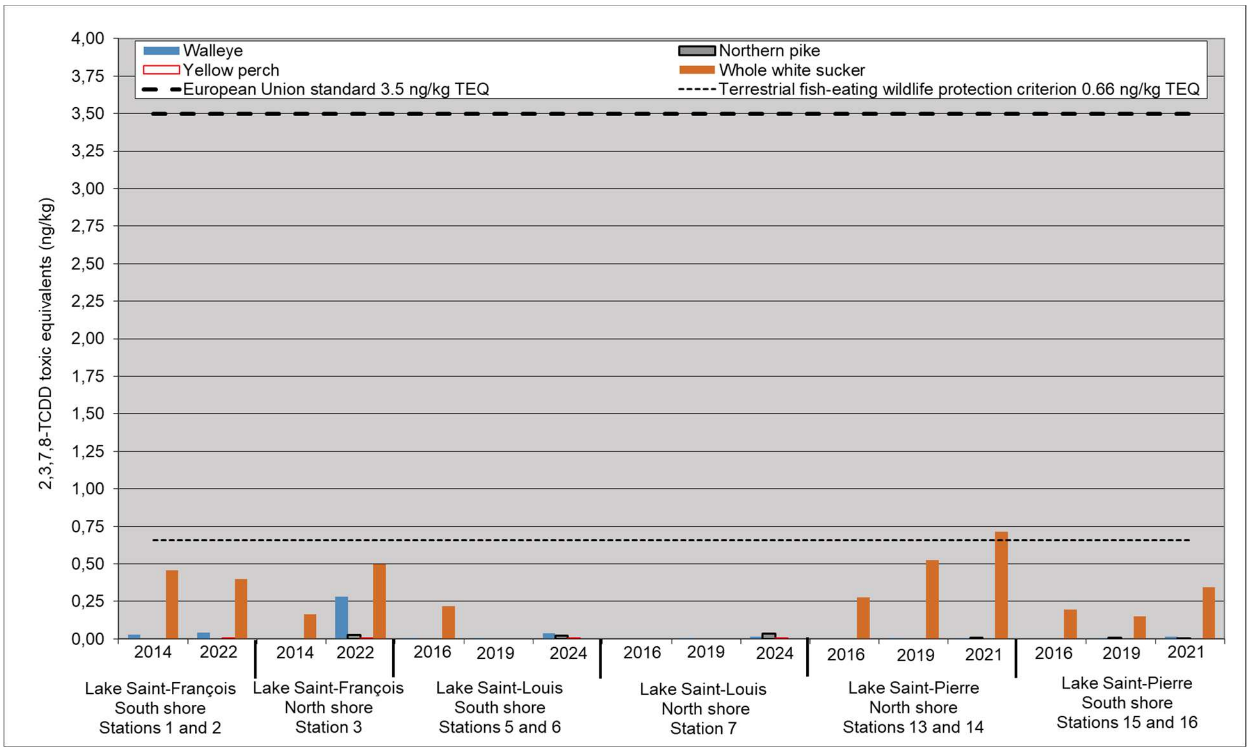

Figure 5: Trends in average concentrations of total 2,3,7,8-TCDD toxic equivalents in the flesh of walleye, northern pike, yellow perch and whole white sucker in the St. Lawrence River for the 2014–2024 period.

PFAS

Of the 37 PFAS analyzed in fish, only 4 were frequently detected. Perfluorooctane sulfonate (PFOS) alone accounted for an average of 85% of total PFAS concentrations. The other three main PFAS detected were perfluorodecane sulfonate (PFDS), perfluorodecanoic acid (PFDA) and perfluoroundecanoic acid (PFUnDA) (Figure 6). Currently, criteria exist only for PFOS, and there are no guidelines yet in Canada for the human consumption of fish; European Union standards[9] vary by species and are difficult to apply to species in Quebec. However, preventive recommendations have been issued advising women planning a pregnancy, pregnant women and breastfeeding women to reduce their monthly consumption of freshwater fish from the St. Lawrence River by half.[3]

From 2019 to 2024, 89% of the average PFOS concentrations, with the exception of three fish flesh samples from Lake Saint-Pierre, exceeded the MELCCFP criterion of 4.6 µg/kg for the protection of fish-eating terrestrial wildlife (mammals).[2] In the flesh of walleye, northern pike and yellow perch, the extent of exceedances ranged from 1.1 to 2.8 times the criterion, while in whole white sucker, exceedances ranged from 6 to 10 times the criterion. The criterion of 8.2 µg/kg for the protection of avian fauna was exceeded in the flesh of walleye, northern pike and yellow perch on nine occasions (33.3%), all located in Lake Saint-François and Lake Saint-Louis. For whole white sucker, 100% of concentrations exceeded the criterion of 8.2 µg/kg; however, no white sucker were captured in Lake Saint-Louis.

In fish flesh, average concentrations ranged from 5.2 to 13 µg/kg for walleye, 3.5 to 7.3 µg/kg for northern pike, and 1.4 to 12.8 µg/kg for yellow perch. The lowest concentration was measured in yellow perch on the north shore of Lake Saint-Pierre in 2021. For whole white sucker, concentrations ranged from 28 to 47.6 µg/kg, with the highest values measured on the south shore of Lake Saint-Pierre in 2019 (46.6 µg/kg) and 2021 (47.6 µg/kg). The next highest values were observed on the north shore of Lake Saint-Pierre in 2019 (37 µg/kg) and 2021 (31 µg/kg), as well as on the south shore (30 µg/kg) and north shore (28 µg/kg) of Lake Saint-François in 2022.

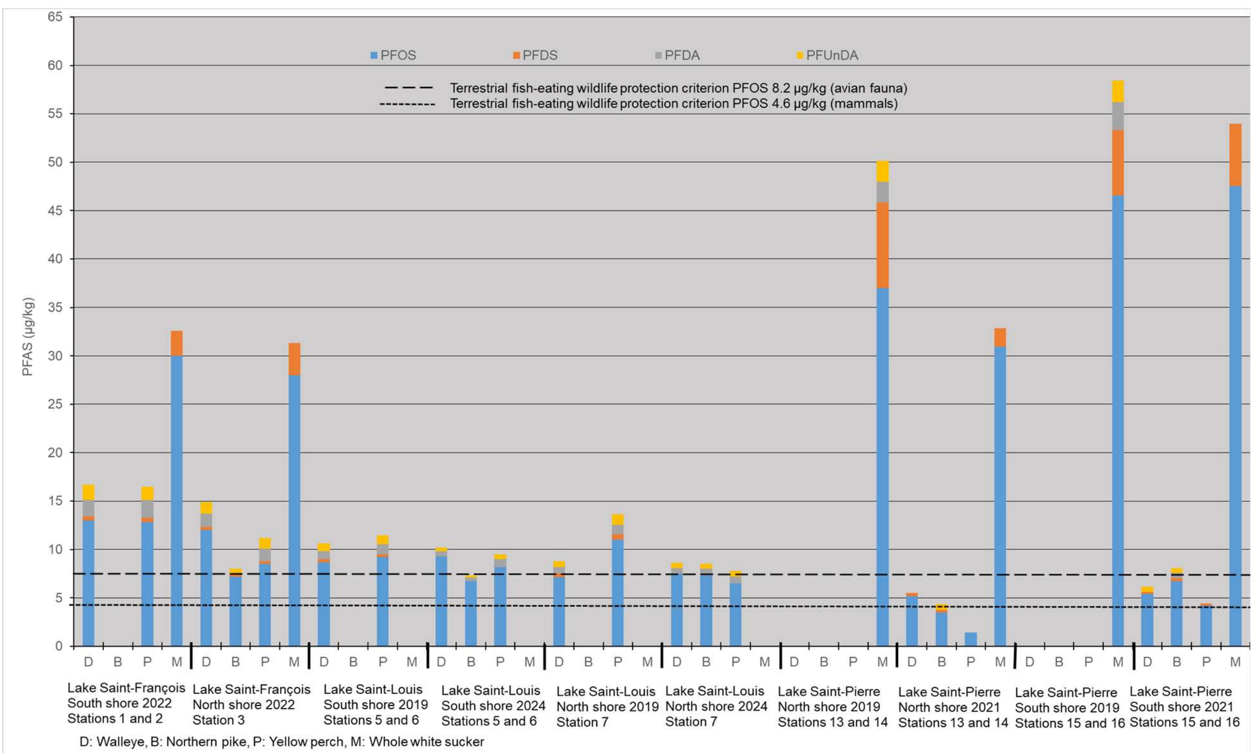

Figure 6: Trends in average PFOS, PFDS, PFDA and PFUnDA concentrations in the flesh of walleye, northern pike, yellow perch and whole white sucker in the St. Lawrence River for the 2019–2024 period.

Outlook

Stricter regulations and several government programs have significantly reduced the discharge of contaminants into the St. Lawrence–Great Lakes system. The available data indicate that concentrations of toxic substances are low enough to permit moderate or occasional consumption of fish from the St. Lawrence, allowing humans to reap the associated health benefits.

For more information

[1] Government of Canada. 2021. Health Canada's Maximum Levels for Chemical Contaminants in Foods, 2021-09-21. Accessed 19 Aug 2025.
Health Canada's Maximum Levels for Chemical Contaminants in Foods - Canada.ca

[2] Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP). Critères de qualité de l'eau de surface. [Surface water quality criteria]. Direction principale de la qualité des milieux aquatiques. [Online]. Accessed 19 Aug 2025.
Critères de qualité de l'eau de surface (gouv.qc.ca)

[3] Guide de consommation du poisson de pêche sportive en eau douce. [Guide to eating freshwater game fish]. Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs du Québec. http://www.environnement.gouv.qc.ca/eau/guide/localisation.asp

[4] Government of Canada. 2021. Mercury and human health – information sheet. Modified 25 Mar 2021; accessed 21 Aug 2025. Mercury and human health - Canada.ca

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[7] Health Canada. Dioxins and furans. Modified 15 May 2017; accessed 21 Aug 2025.
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[10] Environment Canada. 2013. *Canadian Environmental Protection Act, 1999*, Federal Environmental Quality Guidelines: *Polybrominated Diphenyl Ethers* (PBDEs). 28 p. [Online] https://publications.gc.ca/collections/collection_2013/ec/En84-91-2013-eng.pdf

State of the St. Lawrence Monitoring Program

Environment and Climate Change Canada; Fisheries and Oceans Canada; Parks Canada and the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs du Québec—and Stratégies Saint-Laurent, a non-governmental organization that works actively with riverside communities, are pooling their expertise and efforts to provide Canadians with information on the state of the St. Lawrence and the long-term trends affecting it.

For more information about the State of the St. Lawrence Monitoring Program, please consult our website: https://www.planstlaurent.qc.ca/en/developing-knowledge/state-st-lawrence-monitoring-program.

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