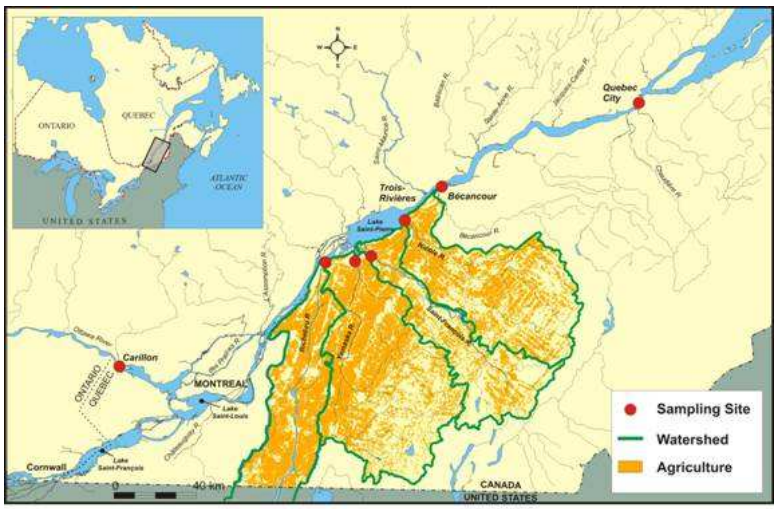
Canada



# Pesticides are Entering the St. Lawrence River through Its Tributaries

A number of pesticides are present in the water of the St. Lawrence River near Quebec City and at the mouths of some tributaries of Lake Saint-Pierre. This is what scientists at Environment Canada have observed since 2003.

**Water sampling for pesticides at the mouths of the Richelieu, Yamaska, Saint-François and Nicolet rivers**



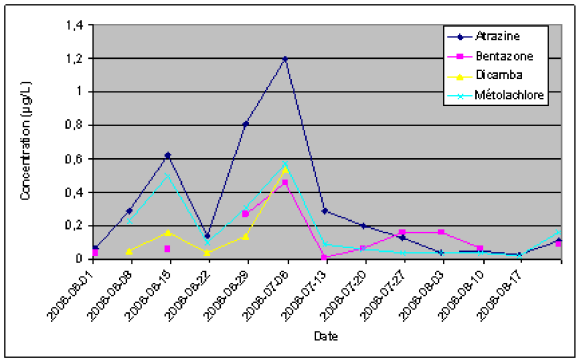

In 2000, Lake Saint-Pierre was declared a World Biosphere Reserve by UNESCO shortly after its designation as a Ramsar site in 1998 under the Convention on Wetlands of International Importance. Characterized by a remarkable biological diversity, this unique ecosystem is located in a rural area where farming activities are likely to threaten its ecological integrity.

**Herbicide, insecticide, fungicide… are they all pesticides?**

A **pesticide** is a generic term for a substance or chemical product capable of controlling, attracting, repelling or destroying living organisms (microbial, animal or plant) that are considered a nuisance or to prevent their development (Wikipedia 2004). These products are distinguished by their specific action to control plants (herbicides), insects (insecticides) or microscopic fungi (fungicides).

Pesticides were applied to over 10,516 square kilometres of Quebec in 2006, or 49 percent more than in 1996 (Statistics Canada, 2006). These consisted mainly of herbicides. The St. Lawrence River, especially Lake Saint-Pierre, is vulnerable to contamination by pesticides because several tributaries draining farming areas empty into it. This is the case for the Nicolet, Saint-François and Yamaska rivers, situated south of Lake Saint-Pierre, where land is used for large-scale agricultural production.

**2006 Pesticide Measurements, Yamaska River**




The Yamaska River basin has the highest proportion of farmland (i.e. half its surface area, mostly corn and soy crops). An estimated 400 tonnes of pesticides are applied each year (Poissant et al., 2008). Of all the sample sites, we detected the highest number of pesticides at the mouth of the Yamaska River. Of these, atrazine and metolachlor were found most frequently and in the highest concentrations. The results are shown below.

| Pesticide and detection frequency in sampled rivers in 2005 | | | | |
|---|---|---|---|---|
| | Percentage of samples containing pesticides | | | |
| | Yamaska | Nicolet | Saint-François | St. Lawrence |
| **Herbicides** | | | | |
| 2,4-D | < 10 | < 10 | < 10 | – |
| 2,4-DB | – | 11-30 | – | – |
| 2,4,5-T | – | – | – | – |

| Pesticide and detection frequency in sampled rivers in 2005 | | | | |
|---|---|---|---|---|
| | Percentage of samples containing pesticides | | | |
| | Yamaska | Nicolet | Saint-François | St. Lawrence |
| Atrazine | > 30 | > 30 | > 30 | > 30 |
| • Deethyl-atrazine* | > 30 | < 10 | – | > 30 |
| • Deisopropyl-atrazine* | 11-30 | 11-30 | – | < 10 |
| Bentazone | > 30 | 11-30 | – | < 10 |
| Bromoxynil | 11-30 | – | 11-30 | – |
| Butylate | – | – | – | – |
| Clopyralid | 11-30 | – | – | – |
| Cyanazine | – | – | – | 11-30 |
| Dicamba | > 30 | > 30 | 11-30 | < 10 |
| Dichlorprop | – | – | – | – |
| Diclofop-methyl | – | – | – | – |
| Dimethenamid | > 30 | – | – | 11-30 |
| Dinoseb | – | – | – | – |
| EPTC | – | – | – | – |
| Fenoprop | – | – | – | – |
| MCPA | 11-30 | 11-30 | 11-30 | 11-30 |
| MCPB | – | – | – | – |
| Mecoprop | > 30 | 11-30 | 11-30 | 11-30 |
| Metolachlor | > 30 | > 30 | > 30 | > 30 |
| Metribuzin | 11-30 | – | – | – |
| Picloram | – | – | – | – |
| Simazine | 11-30 | 11-30 | 11-30 | > 30 |
| Triclopyr | – | – | – | – |
| Trifluralin | – | – | – | – |
| **Fungicides** | | | | |
| Chlorothalonil | 11-30 | – | 11-30 | – |
| Myclobutanil | – | – | 11-30 | – |
| **Insecticides** | | | | |
| Azinphos-methyl | – | – | – | – |
| Bendiocarb | – | – | – | – |
| Carbaryl | – | – | – | – |
| • 1-naphthol** | – | – | – | – |
| Carbofuran | – | – | – | – |
| Chlorfenvinphos | – | – | – | – |
| Chloroxuron | – | – | – | – |
| Chlorpyrifos | – | – | 11-30 | – |
| Diazinon | – | – | – | – |
| Dichlorvos | – | – | – | – |
| Dimethoate | 11-30 | 11-30 | – | 11-30 |
| Disulfoton | – | – | 11-30 | – |
| Diuron | – | – | – | – |
| Fenitrothion | – | – | – | – |
| Flumetsulam | < 10 | – | – | – |
| Fonofos | – | – | – | – |
| Imazethapyr | 11-30 | – | – | – |
| Linuron | – | – | – | – |
| Malathion | – | – | – | – |
| Methidathion | – | – | – | – |
| Methyl-parathion | – | – | – | – |
| Mevinphos | – | – | – | – |
| Nicosulfuron | 11-30 | – | – | – |
| Parathion | – | – | – | – |
| Phorate | – | – | – | – |
| Phosalone | – | – | – | – |
| Rimsulfuron | – | – | – | – |
| Tebuthiuron | – | – | – | – |
| Terbufos | – | – | – | – |

*Atrazine metabolites.
** Carbaryl metabolite.

**Did you know?** The degree of water contamination depends on the physical and chemical properties of the pesticide, the quantity applied, the basin hydrology, and the prevailing weather conditions around the time of spraying

**Concentrations Exceeding Quality Criteria**

| | Concentrations Exceeding Criteria for Agricultural Irrigation | Concentrations Exceeding Criteria for Protection of Aquatic Life |
|---|---|---|
| **Yamaska** | Dicamba (65% of samples)<br>MCPA (30% of samples) | |
| **Nicolet** | Dicamba (frequent)<br>MCPA (frequent) | Chlorpyrifos (occasional) |
| **Saint-François** | Dicamba (20% of samples) | Chlorpyrifos (occasional)<br>Diazinon (occasional) |

Our findings indicate that most pesticide concentrations in the aquatic environment are within quality criteria. Pesticide concentrations are generally highest in the month following its application, and during heavy precipitation (10 mm or more). However, quality criteria for the protection of aquatic life in the Nicolet and Saint-François rivers are sometimes exceeded by concentrations of chlorpyrifos, an organophosphorous insecticide widely used for mosquito control. Quality criteria for agricultural irrigation are more frequently exceeded, most notably by concentrations of the herbicide dicamba in the three rivers and by MCPA in the Yamaska and Nicolet rivers.

**What are the potential consequences of exceeding quality criteria?**

Irrigation is required primarily for vegetable production and ornamental production. When pesticide concentrations exceed the criteria for agricultural irrigation, it becomes risky to use the water as an irrigation source since it could damage crops

As for the potential effects of chlorpyrifos on aquatic organisms, the substance tends to bioaccumulate in fish and algae. Symptoms of chlorpyrifos toxicity include lack of motor coordination, delayed maturation and growth, and reproductive impairment (Canadian Water Quality Guidelines for the Protection of Aquatic Life, 2008).

We should also consider the cumulative effect of various pesticides that exist simultaneously in the water (which can affect aquatic species, even if individual pesticide concentrations are within quality criteria). The lack of quality criteria for various pesticides may also lead to an underestimate of their potential impact on the environment.

**Lake Saint-Pierre Pesticide Inputs**

| | Atrazine (kg) | Metolachlore (kg) | Dicamba (kg) |
|---|---|---|---|
| **Yamaska** | 129 | 79 | 34 |
| **Nicolet** | 41 | 30 | 12 |
| **Saint-François** | 53 | 28 | 28 |
| **TOTAL*** | 223 | 137 | 74 |

*Estimate, June 1 to 30

While the input of pesticides entering from the sampled tributaries appears negligible compared to the quantity of pesticides exiting the Great Lakes (see Lake Ontario: The Main Source of Herbicides in the St. Lawrence (http://www.qc.ec.gc.ca/csl/inf/inf006_003_e.html)), the Yamaska River, whose daily inputs of atrazine can reach 27.7 kg, is likely to contribute significantly to water contamination in Lake Saint-Pierre.

**What is Environment Canada Doing?**

A number of federal departments (i.e. Agriculture and Agri-Food, Environment, Natural Resources, Health, Fisheries and Oceans, etc.) have programs to study the effects of pesticides on the environment. Most of Environment Canada's research concerns surface water and wildlife contamination.

Environment Canada's Obsolete Pesticide Product Management Program is a voluntary program for producers. "The main objective of the program is to partner with government agencies to collect and safely dispose of obsolete or banned pesticides throughout rural communities in Canada, at no cost to the farmer" Environment Canada, 2007 (http://www.ec.gc.ca/epr/default.asp?lang=Fr&n=38EE2119-1).

Environment Canada thus continues to work to improve its knowledge of the presence and fate of pesticides in the tributaries of Lake Saint-Pierre and the mouth of the St. Lawrence at Quebec City.

**Related Links**

Projects
Presence of Pesticides in the St. Lawrence River and its Tributaries (http://www.qc.ec.gc.ca/csl/pro/pro028br_e.html)

St. Lawrence Info

Lake Ontario: The Main Source of Herbicides in the St. Lawrence River (http://www.qc.ec.gc.ca/csl/inf/inf006_003_e.html)

Monitoring Water Quality at Quebec (http://www.qc.ec.gc.ca/csl/inf/inf006_e.html)

Monitoring the Water Quality in the Fluvial Section: Physico-chemical and Bacteriological Parameters (http://www.qc.ec.gc.ca/csl/inf/inf009_e.html)

Ministere du Developpement durable, de l'Environnement et des Parcs du Quebec – Les pesticides (http://www.mddep.gouv.qc.ca/pesticides/inter.htm) *(French only)*

Centre d'expertise en analyse environnementale du Quebec (http://www.ceaeq.gouv.qc.ca/index.htm)

**Reference Material**

Canadian Council of Ministers of the Environment, 2008. Canadian Water Quality Guidelines for the Protection of Aquatic Life – chlorpyrifos. In: *Canadian Environmental Quality Guidelines*, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Poissant, L., C. Beauvais, P. Lafrance and C. Deblois. 2008. "Pesticides in fluvial wetlands catchments under intensive agricultural activities". *Science of the Total Environment*, *404* (1): 182-195.

Statistics Canada. 2006 Census of Agriculture (http://www.statcan.gc.ca/ca-ra2006/index-eng.htm) (online). Consulted April 2009.

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