

Monitoring the State of the ST. LAWRENCE RIVER

SEDIMENTS

WATER

SHORELINES

BIOLOGICAL RESOURCES

USES



Butyltins in Sediments of the St. Lawrence River

Background

Butyltins are organometallic compounds that have been used as biocides in antifouling paints for ship hulls; as fungicides, insecticides and wood preservation products; and as stabilizers in polyvinyl chloride since 1960. Butyltins can be measured in sediments in the form of tributyltin (TBT) and its degradation products, dibutyltin (DBT) and monobutyltin (MBT). These substances are persistent in the environment and bioaccumulate in aquatic organisms. Because TBT is highly toxic, the use of TBT paints for small vessels (less than 25 m) was regulated in Canada in 1989; however, it was still allowed for larger boats until 2002. In addition, the *Prohibition of Certain Toxic Substances Regulations, 2012* prohibits the manufacture, use, sale, and offer for sale or import of TBT in Canada. As a part of a collaboration between monitoring and research programs on chemical contamination in the St. Lawrence River, 250 sediment samples were analyzed in order to determine current butyltin concentrations in sediments along the St. Lawrence.

Overview of the Situation

St. Lawrence River

Surface sediment samples were collected between 2003 and 2010 in the three fluvial lakes, the fluvial section, Montreal harbour—both inside and outside of the port area—and the seaway locks and Lachine Canal. The results showed that

50% of samples contained one of the three forms of butyltin and that MBT was the form most frequently detected. The majority of stations (74%) had little or no contamination, with concentrations of less than 5 ng tin/g (5 ng Sn/g). The rest of the stations contained less than 100 ng Sn/g and can be considered as contaminated by butyltin. These stations are mainly located in the depositional basins of the fluvial lakes.

Marinas

Sediment samples were collected in 20 marinas located between Cornwall and Trois-Rivières. All samples contained detectable concentrations of butyltins. The most common form was MBT in 95% of cases. Each quality class contains about one third of the stations (See section : Contamination Thresholds for Butyltins). Some stations had concentrations exceeding 200 ng Sn/g.



Ship on the seaway. © M.Pelletier

Table 1 Descriptive statistics and evaluation of sediment quality in groups of stations

	Substance	n	Percentage of detection (%)	Minimum value (ng Sn/g)	Median value (ng Sn/g)	Maximum value (ng Sn/g)		Quality classes*	Percentage of stations
River	MBT	136	40	< 0.7	< 0.7	89.2	River	Little or no contamination	74
	DBT	136	17	< 0.5	< 0.5	9.1			
	TBT	136	23	< 0.4	< 0.4	66.0		Contaminated	26
	Total BT	136	53	DL	0.9	91.3		Very contaminated	0
Contre-Cœur	MBT	16	50	< 0.7	< 0.7	12.1	Contre-Cœur	Little or no contamination	44
	DBT	16	63	< 0.5	1.4	480.0			
	TBT	16	69	< 0.4	2.7	1603.0		Contaminated	31
	Total BT	16	100	0.4	10.1	2092.5		Very contaminated	25
Port of Montreal	MBT	49	47	< 0.7	< 0.7	170.0	Port of Montreal	Little or no contamination	12
	DBT	49	65	< 0.5	5.5	259.4			
	TBT	49	76	< 0.4	31.0	1099.0		Contaminated	51
	Total BT	49	92	DL	54.2	1341.0		Very contaminated	37
Marinas	MBT	20	95	< 0.7	1.7	120.0	Marinas	Little or no contamination	35
	DBT	20	70	< 0.5	3.4	96.9			
	TBT	20	65	< 0.4	3.5	150.0		Contaminated	35
	Total BT	20	100	1.1	14.3	222.0		Very contaminated	30
Locks	MBT	7	86	< 0.7	1.4	7.3	Locks	Little or no contamination	0
	DBT	7	100	8.0	17.6	59.7			
	TBT	7	100	0.2	58.0	455.0		Contaminated	71
	Total BT	7	100	9.4	76.0	515.3		Very contaminated	29
Lachine Canal	MBT	6	86	0.8	4.0	8.4	Lachine Canal	Little or no contamination	17
	DBT	6	100	0.4	5.9	26.2			
	TBT	6	100	1.8	5.1	50.7		Contaminated	83
	Total BT	6	100	4.5	15.7	85.3		Very contaminated	0

Legend: BT – butyltin; DL – Detection limit, n – number of samples

*See section Contamination Thresholds for Butyltins

Port of Montreal

The Port of Montreal is located along the south shore of the Island of Montreal, between the Lachine Rapids and Pointe-aux-Trembles. Butyltins were present in 92% of surface sediment samples collected at 49 stations near the main piers. The basins of the maritime and Bickerdike terminals in the upstream section of the port are the most heavily contaminated, with values of 1341 ng Sn/g and 356 ng Sn/g, respectively. TBT was detected in over 75% of analyses and was the main form of butyltin.

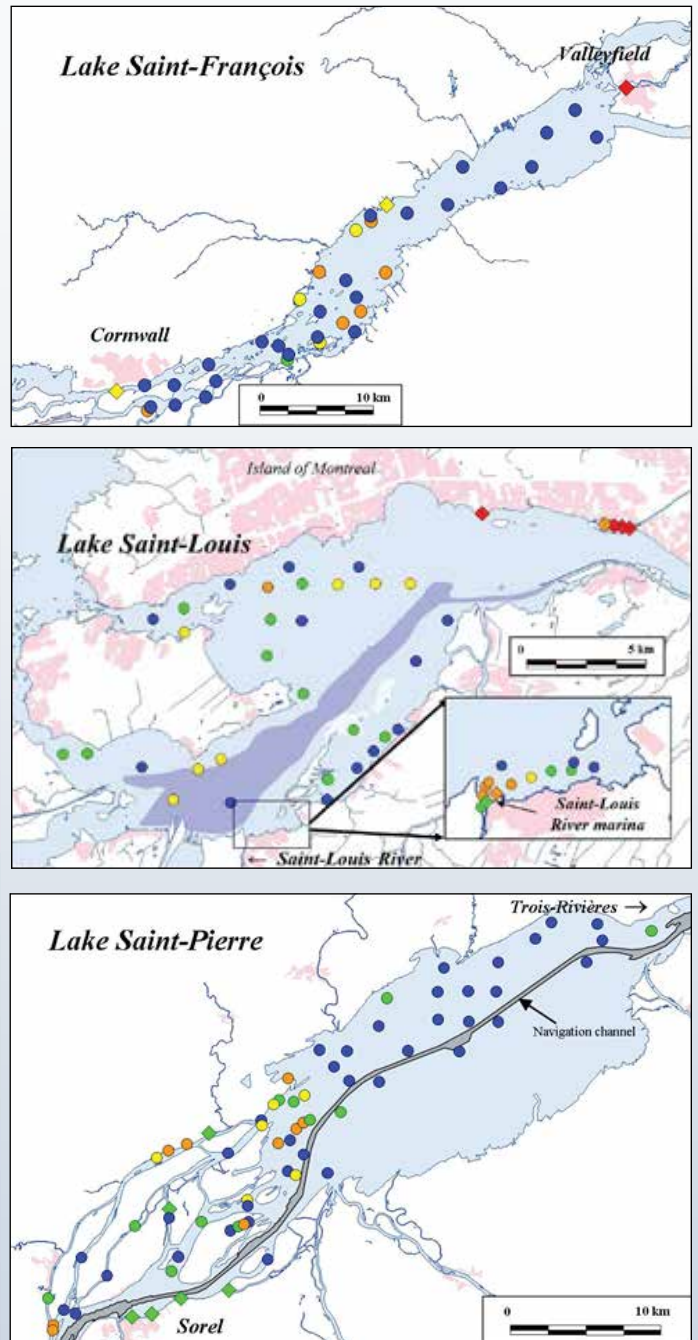
More than half (51%) of all stations were contaminated, with values between 5 and 100 ng Sn/g, while 37% of stations had contamination levels exceeding 100 ng Sn/g.

Contamination Thresholds For Butyltins

In the absence of Canadian quality criteria for assessing the quality of butyltin-contaminated sediments, we used as guideline values the quality criteria for tributyltin developed in Norway for sediments in saltwater (Bakke et al. 2010) and the “interim” criteria proposed for port areas in the Great Lakes (Bartlett et al. 2005). Taking the total of the three forms of butyltin into consideration, we established three categories of contamination (see legend), which were subdivided into colour subclasses to better present the results on concentration maps. It is important to specify that these quality classes are arbitrary and should not be considered as criteria or standards.

Legend		
Symbols	Quality Classes	Butyltin Concentrations
■ Port of Montreal	Very contaminated	■ > 800 ng Sn/g
◆ Marina		■ 100 to 800 ng Sn/g
● St. Lawrence River	Contaminated	■ 20 to 100 ng Sn/g
▲ Contrecoeur		■ 5 to 20 ng Sn/g
	Little or no contamination	■ 1 to 5 ng Sn/g
		■ < 1 ng Sn/g

Figure 1 Distribution of butyltin concentrations in sediments of fluvial lakes



Contrecoeur

The Contrecoeur Islands sector, located in the fluvial section of the river between Montréal and Lake Saint-Pierre, is a natural environment that has been designated a National Wildlife Area. Surface sediments in this sector contained butyltins: 56% of sampling stations had sediments that were contaminated or heavily contaminated.

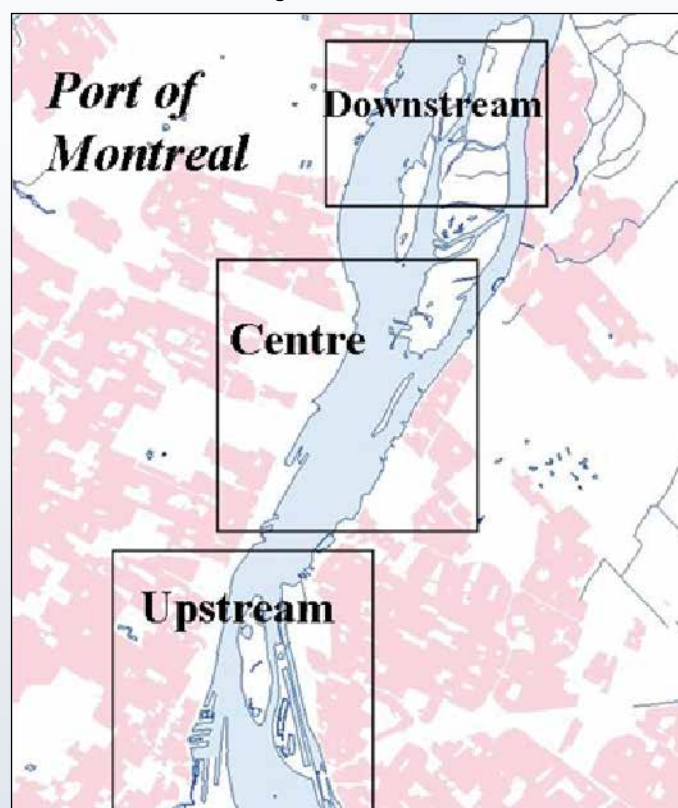
The two highest concentrations (2093 ng Sn/g and 982 ng Sn/g) are mainly in the form of TBT and could have an effect on benthic organisms. These concentrations greatly exceed the interim criteria of 800 ng Sn/g proposed for port areas in the Great Lakes (Bartlett et al. 2005). These concentrations are located in an area of slow-moving water a few kilometres downstream of a transshipment pier located on the river and used occasionally.

Seaway Locks and Lachine Canal

Some surface sediment samples collected in seaway locks (Saint-Lambert and Sainte-Catherine) showed the presence of butyltins, with a median value of 76 ng Sn/g and a maximum value of 515.3 ng Sn/g.

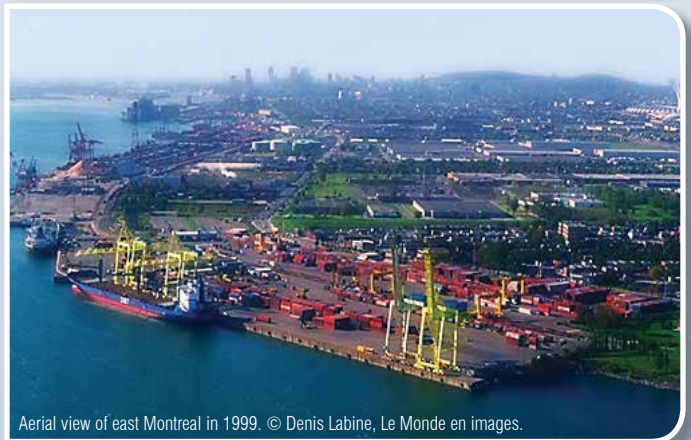
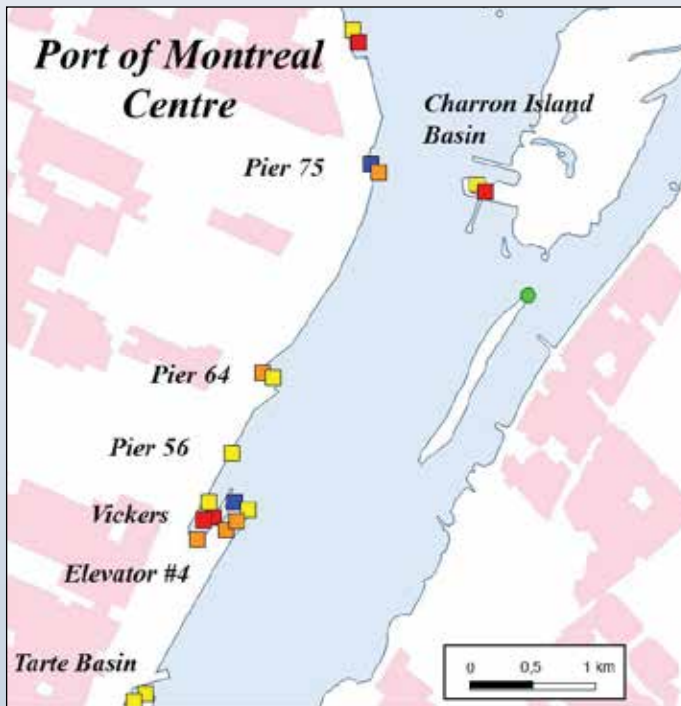
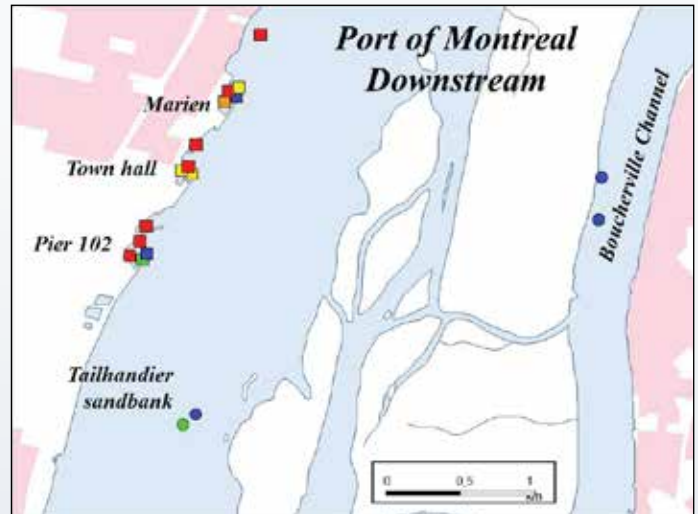
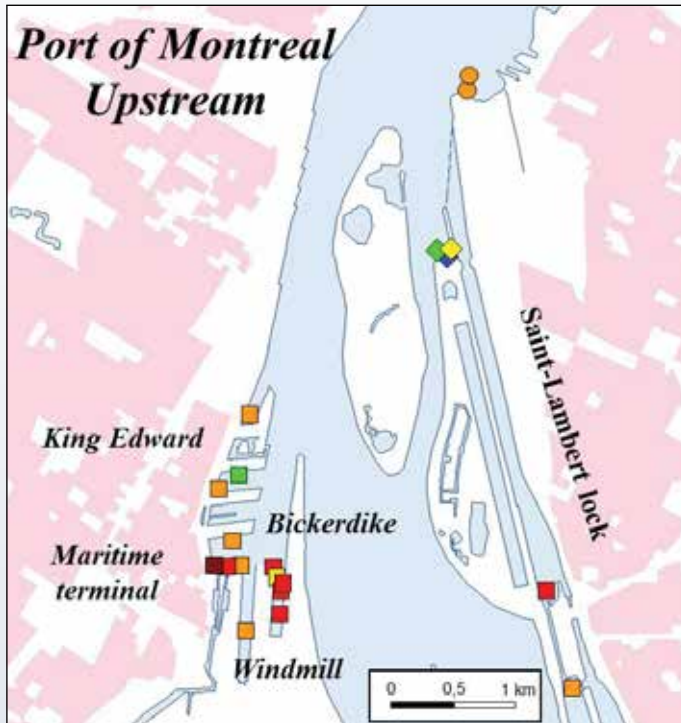
Sediments of the Lachine Canal showed relatively low concentrations (maximum 85 ng Sn/g) compared with those observed in the marina at the canal entrance (maximum 222 ng Sn/g), a potential source of butyltins in the Lachine Canal.

Figure 2 Location of sectors in the Port of Montreal showed in figure 3



Channel of Îles de Contrecoeur, 2010. © M. Pelletier

Figure 3 Distribution of butyltin concentrations in sediments in the Port of Montreal



State of the St. Lawrence Monitoring Program

Four government partners – Environment Canada, Fisheries and Oceans Canada, Parks Canada Agency, and the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques – and Stratégies Saint-Laurent, a nongovernmental 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 its long-term evolution.

To this end, environmental indicators have been developed on the basis of data collected as part of each organization's ongoing environmental monitoring activities. These activities cover the main components of the environment, namely water, sediments, biological resources, uses and shorelines.

For more information on the State of the St. Lawrence Monitoring Program, please visit our Web site at <http://www.planstlaurent.qc.ca/>.

For More Information

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