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The Changing Nature of a River: Aspects of the Biological Integrity of the St. Lawrence

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Good Morning,

It is my pleasure to be here with you today to talk about the changing nature of the St. Lawrence River. I would like to show you some examples of changes in the biological integrity of the river, particularly in wetlands.

Overview

- Is the St. Lawrence River healthy?
- Historical changes:
 - in wetlands
 - in species composition
- Other changes
- The next step: A Monitoring Program

I would like to begin by asking the question, Is the St. Lawrence River healthy?, and then attempt to answer this question with examples of the historical changes that have taken place in wetland areas, both in terms of size and species composition.

I will then briefly show you examples of other studies we are conducting on biological integrity.

My presentation ends with a look at our present monitoring program on the St. Lawrence River.

The St. Lawrence River: A Few Facts

- One of the largest rivers in the world
- 70% or 5 million Quebecers live along its shores



You probably already know that the St. Lawrence River is one of the largest rivers in the world. It is the main outlet of the Great Lakes. In Québec, about 5 million people live along its shores and every year, 10 000 registered vessels move nearly 100 million tonnes of goods on these waters. So, the river is subject to heavy use by humans.

Is the St. Lawrence River Healthy?

- Little baseline data are available to determine the characteristics of a healthy St. Lawrence River
- There is no question that the physical pressures on the St. Lawrence River have undermined the biological integrity of the system



Because we as humans rely so heavily on the river, we are forced to ask the question: Is the St. Lawrence healthy? In order to answer this question, however, we need baseline data with which to determine the characteristics of a healthy river. Unfortunately, such data are rare.

But there is no question that more than four centuries of intensive use of the river and its shore have greatly changed its face.

We also know that a river system is by nature dynamic: it changes over time, regardless of whether or not humans use it.

We then have to ask ourselves: how should we preserve our remaining habitats? To what purpose? How do we deal with changes?

We are taking a multi-indicator approach to try to answer these questions

Times Have Changed...



Source: La Presse, Oct. 7, 2000, B2

This picture illustrates an example of the dynamic nature of the river. It was taken in 1888 on Notre-Dame Street in Montreal. This street is located approximately 2 km from the present-day shoreline. The St. Lawrence River obviously had a huge influence on human activities at that time.



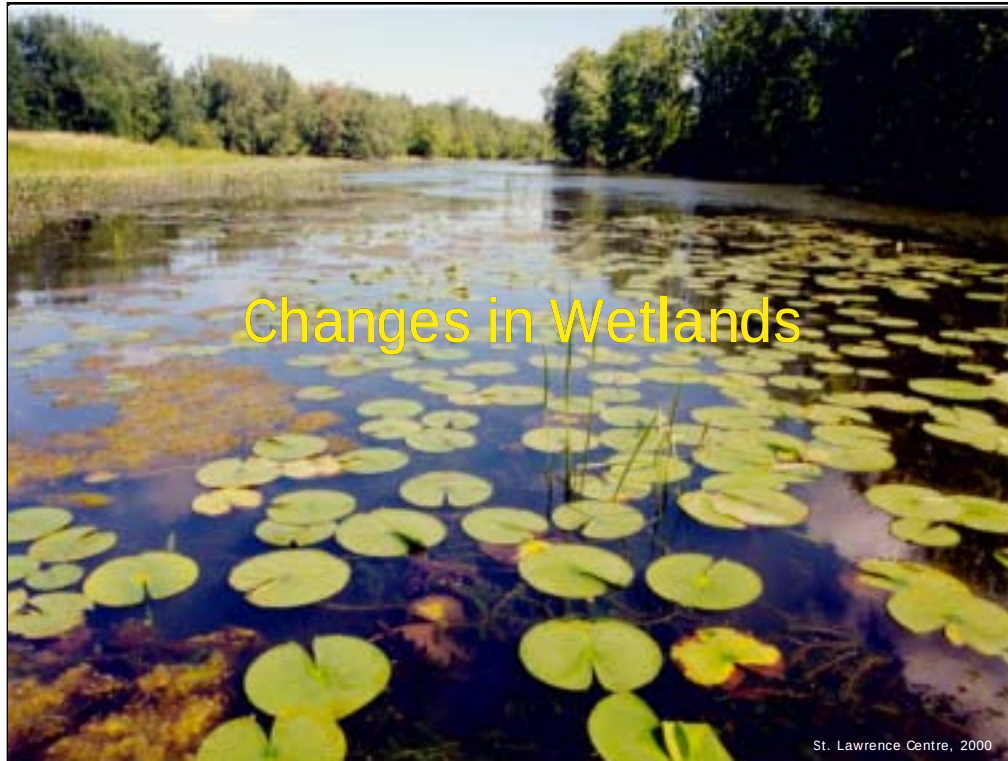
This picture, taken near the Old Port, shows a waterline on a building, again illustrating the influence of the river on the lives of our ancestors.



During the flood of April 1886, the height of the water was about 10 metres above the present level of the St. Lawrence. We now manage the river, so events of this magnitude do not happen anymore. We built the St. Lawrence Seaway and raised structures for hydroelectricity production and in so doing severely altered the natural fluctuations of the water level.

The river is much kinder to us today compared to that earlier time, which is not so far away. More importantly, we have gotten used to the peaceful state of the river.

But the river is still dynamic. It continues to change with time.



One important change in the river involves wetlands. Wetlands, I am sure we all agree, are incredibly important to the overall health of the river.

Montreal's Wetlands and Watercourses: 1542 - 1642



Adapted from Beaugrand-Champagne, 1942

Again, a look at the past shows us the importance of wetland ecosystems. The island of Montreal had a huge number of watercourses and, presumably, wetlands. Even its shape was different, especially downstream. The island of Montreal that was founded by French settlers was thus very different from what it looks like today. We do not need a study to confirm what we already know: that the biological integrity of this section of the river has changed.

Wetland Losses



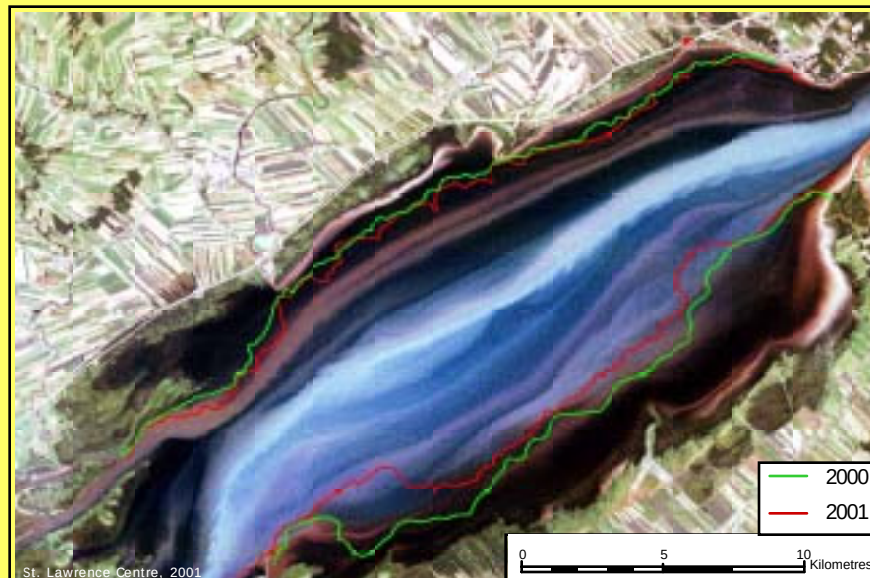
- 80% of wetlands have been lost since French settlement
- 50% of the shoreline between Cornwall and Quebec City has been altered by agriculture and urban development

In fact, various studies have shown that 80% of the wetlands along the river have been lost since French settlement.

Today, 50% of the shoreline between Cornwall and Quebec City has been altered by agriculture and urbanization.

If we add the impacts of invasive species and climate change, we have the right to be worried. So we have made, and still make, great efforts to protect the remaining wetland areas. Unfortunately, putting a fence around a wetland is often not enough to assure its long-term integrity. We must remember that the river is dynamic. So, wetlands will also change, as they are closely related to this characteristic of the system, especially water-level fluctuations.

Wetlands in Transition



In fact, water-level fluctuation is a determinant, driving force structuring wetlands. Healthy wetlands must be allowed to experience variations in water levels, both in terms of frequency and amplitude, that destroy terrestrial plants, allow wetland species to become established, and permit re-establishment from reserves of buried seeds.

This picture of Lake St. Pierre illustrates the ever-changing nature of wetlands. The green lines show the lower limit of marshes in year 2000, an average year in term of water levels, whereas the red ones indicate the same limit in marsh vegetation in 2001.

This variation in water levels can lead to conditions where, sometimes, wetlands look like...

Wetlands *Can* Look Like This!



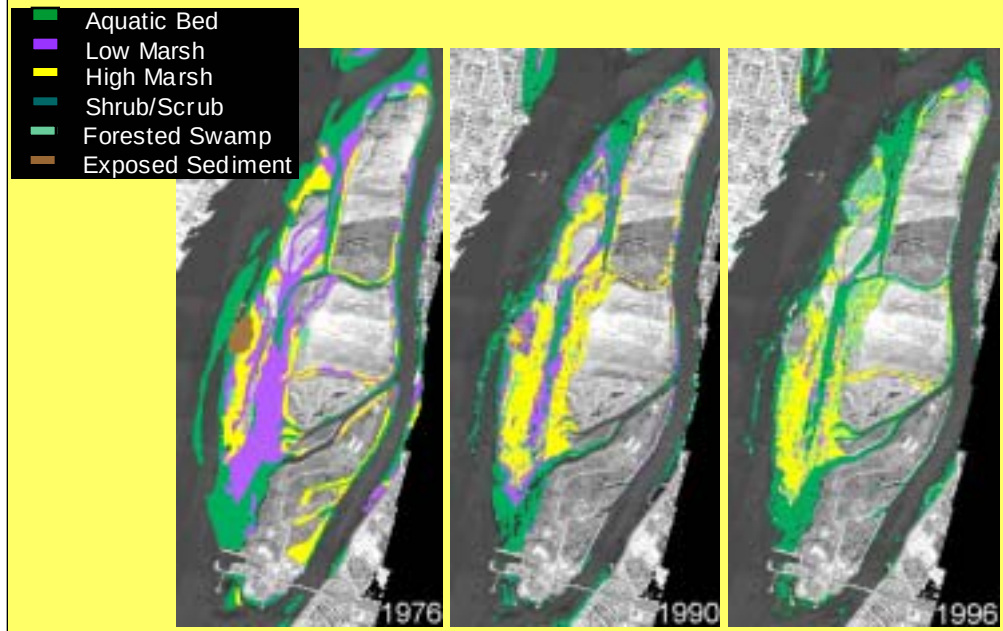
this. Mudflats are then exposed to plant colonization. The problem is when this situation occurs too often. That is when wetlands are susceptible to being invaded by non native species or terrestrial vegetation.

Wetland Monitoring: Study Area



Our last snapshot of the dynamic nature of wetlands was taken in the late 1970s, so we are currently working to update our information. We use remotely sensed images to map and compare the distribution and composition of wetlands on a major section of the river, stretching from Cornwall, Ontario to Trois-Pistoles, a distance of 560 km. A significant portion of the 63 000 ha of wetlands is mainly located in Lake St. Pierre and Lake St. Francis. Our results show that not all wetlands have changed in a similar manner since the 70s. Some of them are still being destroyed for agriculture or for other human activities. Some are transformed by unusual hydrological events, occurring since we transformed the hydrology of the river. Others exhibit internal changes in wetland types or species composition. I will present the example of the Boucherville islands, near Montreal.

Boucherville: 1976 - 1996

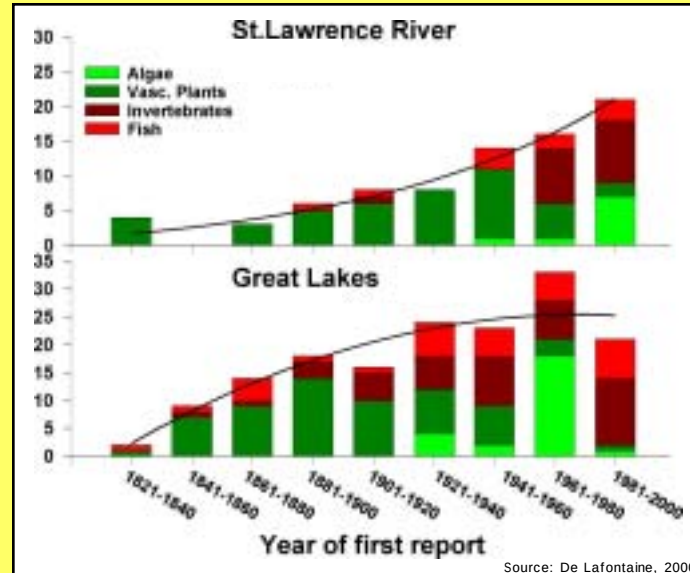


These maps illustrate wetlands from 1976 to 1996. You can see an important change where low marshes, shown here in purple, were transformed into high marshes. One hypothesis for this phenomenon pointed to the dredging of the Montreal harbour that diverted water to the ship channel and then locally lowered the level of waters flowing through wetlands. This could be an interesting example of an indirect effect of human activities on nearby wetlands.



It is easy to imagine that such alterations can induce changes in the biological integrity of wetlands. It could also promote the establishment of non native species.

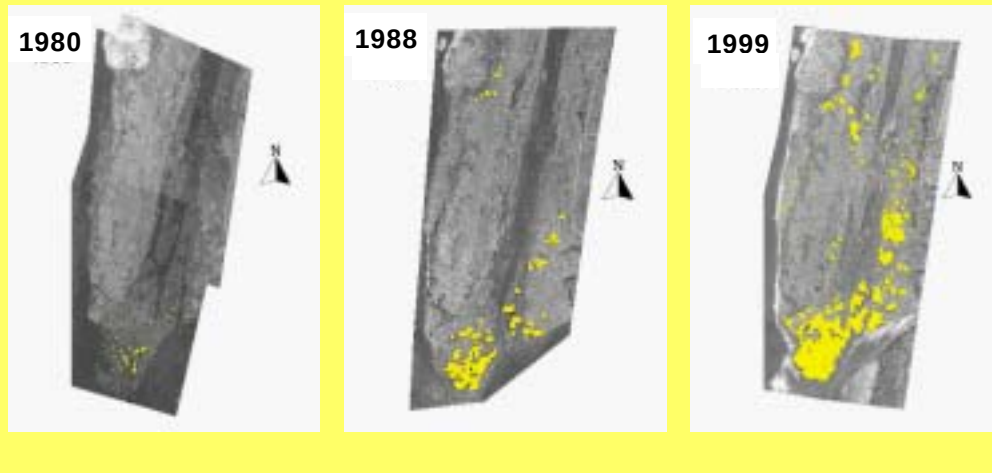
Non-Native Species: St. Lawrence River vs. Great Lakes



My colleague, Yves de Lafontaine, spoke on the situation of non native species in the St. Lawrence River at SOLEC 2000. He showed that the rate of introduction is still rising on the river compared to what seems to be a plateau in the Great Lakes. It would appear, therefore, that the introduction of non-native species to the St. Lawrence River should remain high in the near future.

Example: water chestnut (*Trapa natans*) in one of the St. Lawrence's tributaries.

Common Reed (*Phragmites australis*)



If we look back at the Boucherville islands example, we can see here the progression of the distribution of common reed where low marshes had been replaced by high marshes. This species was very rare in 1980 and reached 25 ha in 1999.

Using field data, we were able to calculate the relative plant cover occupied by non-native species. It is relatively high in some sectors of the fluvial section near Montreal (42-44%), but low (6-10%) in the estuarine sectors.

Purple loosestrife (*Lythrum salicaria*) is the most common non-native species, but flowering-rush (*Butomus umbellatus*), reed canary grass (*Phalaris arundinacea*), and Common reed (*Phragmites australis*) are much more invasive.

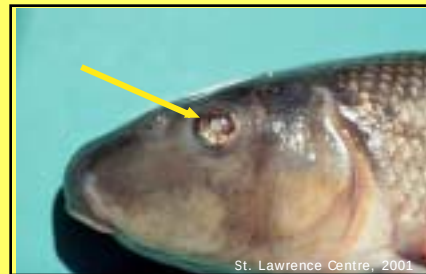


Changes in biological integrity are not exclusive to wetland vegetation. I will very briefly show you two more examples of modifications to other components of the ecosystem.

Other Indicators of Biological Integrity

- Parasites

- Use parasites to help evaluate food web structure and trophic interactions
- Use parasite communities as indicators of pollution, other stressors and biodiversity



Since parasites are linked to almost every level of the food web, they can be used as indicators of changes in the integrity of the food web caused by pollution or other stressors.

Other Indicators of Biological Integrity

- Mussels
 - Mussels are used to evaluate the impact of estrogenic chemicals
 - Mussels exposed for one year to a municipal effluent plume have an increased female/male ratio
 - Feminization of mussels apparent 11 km downstream of the plume



The last example I would like to show you is the problem of new chemicals. In the Montreal area, there is a significant concentration of pharmaceutical industries. In recent years, we found the presence of estrogenic chemicals in the effluent plume of the municipal wastewater treatment plant and we exposed mussels to this plume. We found that the female/male ratio increases in mussels exposed to estrogenic substances. This kind of modification of biological integrity will raise more concern in the near future.

What is Monitored Now?

- Water
 - Toxic substances
 - Physical and chemical characteristics
 - Levels and flows
 - Water quality
- River Bed
 - Toxic substances
- Biological Resources
 - Wetlands
 - Marine plankton
 - Toxic algae
 - Fish
 - Seabirds
 - Great Blue Heron
 - Northern Gannet
 - Beluga Whale

These are only a few examples of studies related to the biological integrity of the St. Lawrence River. We initiated a monitoring program in 1999 to assess the health of the St. Lawrence. Specific monitoring studies are conducted to document various characteristics of the water, the river bed and the biological resources of the river.



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