LE FLEUVE

NEWSLETTER
ST. LAWRENCE VISION 2000

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IN TUNE

The effects of water level fluctuations on the St. Lawrence ecosystem

ASeasonal variations in water levels are crucial for most components of the St. Lawrence ecosystem. The water level subcommittee, which operates under the biodiversity component of SLV 2000, is carrying out projects to quantify the impacts of such variations.

Modelling the St. Lawrence freshwater ecosystem: a scientific and management tool

Researchers are developing a model that describes the dynamics and ecosystem behaviour of the freshwater section of the St. Lawrence. This work will provide a better understanding of the effects of such water-level fluctuations and thus help us improve management methods.

ZIP Chronicle

Due to pollution in shellfish areas, the recreational harvesting of molluscs may involve certain health risks. Health Canada and the Quebec Department of Health and Social Services are working in tandem with the Baie des Chaleurs, Îles de la Madeleine and Rive Nord de l'Estuaire ZIP committees to inform citizens of the problem. Each ZIP committee has established its own action plan for its specific target audience.

The effects of water level fluctuations on the St. Lawrence ecosystem

In the St. Lawrence, seasonal and annual water level variations are crucial for most components of the ecosystem, as well as for related uses of the river. The climate change that is anticipated in the medium term, however, will likely modify both water levels and their variability. Unfortunately, the consequences of climate change and the many human activities that take place on the river are still poorly understood. Under the biodiversity component of St. Lawrence Vision 2000, the water level subcommittee has been mandated to quantify the effects of water level variations on the biological components of the St. Lawrence ecosystem and on uses of the ecosystem. This article will describe the main projects being carried out by subcommittee members.

Water level fluctuations in the St. Lawrence result from the combined action of a number of natural processes, particularly climate and climatic variations.

Human activities may also play a role in affecting water levels. Prime examples include the water level and streamflow control and management structures on the St. Lawrence and Ottawa Rivers, which are used to limit spring flooding, and facilitate commercial shipping and hydroelectric power generation. The construction of the St. Lawrence Seaway also brought about considerable changes in streamflow. Dredging of the shipping channel and shoals, which concentrates the flow in the main channel and reduces current speed in the shallows, has had an ongoing effect on water levels.

Many different criteria are used to evaluate water quality in the St. Lawrence; these criteria relate to such things as the protection of aquatic life, drinking water and swimming. The relationships between the river ecosystem and the quantity of water that passes through it seem to be

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less well known, however. Water availability and seasonal fluctuations in water levels on the St. Lawrence are major issues that must be dealt with, particularly if inflows from the Great Lakes Basin are reduced, as most climate models predict. This may jeopardize the protection of biological resources and the maintenance of a wide variety of river uses, due to the absence of the specific water level conditions they require.

An integrated multidisciplinary approach

The water level subcommittee was established to increase our knowledge of the impact of water level fluctuations on the freshwater St. Lawrence ecosystem (between Cornwall and Quebec City). The committee consists of representatives of Environment Canada (the Canadian Wildlife Service, Canadian Meteorological Centre and the St. Lawrence Centre) and the Société de la faune et des parcs du Québec, who work in partnership with the university community. The committee's objectives are to acquire the knowledge required to predict the effects of water level fluctuations and, secondly, to develop tools that integrate the responses of different ecosystem components, according to different water level fluctuation scenarios.

The subcommittee's multidisciplinary character is one of its greatest assets. Experts from fields as wide ranging as biology, engineering, geography, sedimentology and social economics work together on projects, and in close collaboration with modelling and geographic information system specialists. Contributions from each of these disciplines are essential in establishing an integrated vision of the effects of water level fluctuations on the ecosystem.

Vegetation and wetlands, indicators of water level fluctuations

Water level variations help to maintain and renew the wetlands along the St. Lawrence by insuring the survival of plant species specifically adapted to a regime of flooding in spring and low water levels in summer. A number of studies have been carried out on submergent and emergent vegetation to better understand wetland dynamics.

For example, the Canadian Meteorological Centre is working on a model of the biomass and species composition of submergent and emergent plant communities and their effects on currents, waves and sediments. Concurrently, the St. Lawrence Centre has been monitoring plant growth annually at a number of sites along the river since 1993. The goal of these annual studies is to determine if the low water levels observed since 1998 have resulted in the disappearance or proliferation of certain species of aquatic plants and to evaluate how quickly plant communities are adapting to various water level conditions. The study will also allow us to determine the extent to which opportunistic terrestrial plants have colonized dried-up wetlands.

Critical consequences for wildlife

Wetlands, of course, are not only intrinsically valuable but are used by a wide variety of fishes, amphibians, birds and mammals, which feed or take shelter there at various stages of their life cycle. The northern pike, one of the fish species that frequents the St. Lawrence floodplain, is being studied by the Société de la faune et des parcs du Québec and Environment Canada. The purpose of the research project is to determine how extreme water levels may modify the area of the floodplain and thus affect reproductive success and population dynamics in this species. During the study, natural and managed habitats for the main species of fish inhabiting the floodplain and river corridor (such as northern pike, yellow perch, walleye, white sucker, lake sturgeon and chubs) will also be mapped.

Lake St. Pierre is a crucial staging area for waterfowl during spring migration. Insufficient water levels may result in decreased reproductive success in some species. The Canadian Wildlife Service is carrying out a study to determine, among other things, the effects of water levels on the distribution of habitats around Lake St. Pierre and to ascertain optimum water levels for waterfowl.

Some river uses in jeopardy

Environment Canada is also conducting research on the interactions between water level variations and bank erosion on the St. Lawrence. This is a particularly complex subject, since erosion can be attributed to various factors, both natural (wind and ice) and manmade (shipping), the intensity of which varies with the season and water level conditions. Erosion is particularly severe on a number of islands between Montreal and Sorel which provide prime habitat for the river's aquatic and terrestrial fauna.

In addition, the St. Lawrence Centre is evaluating the vulnerability of boat launches and other types of water access and pleasure boating infrastructures to water level variations. Indeed, pleasure boating is an important recreational and tourism activity in riverside communities. Due to shallow water or the proliferation of submergent aquatic plants, boat launches, piers and wharves may become unusable.

In conclusion, although only some of the projects carried out by the water level subcommittee are described here, the wide range of subjects dealt with eloquently illustrates the diversity of resources and uses that may be affected by water level fluctuations. The knowledge acquired in these projects will be used to provide data for the models. The ultimate goal of the models is to predict, based on various extreme scenarios, the effects of water level fluctuations on the components of the St. Lawrence ecosystem.

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Photo caption: Aerial photo of the Pointe aux Trembles region in 1994 when water levels were equivalent to the 30-year mean, that is, higher than the datum level of bathymetric charts.

Photo caption: Photo of the same area taken in 1999 when the water level was over a meter lower.

Photos : Environnement Canada

Modelling the St. Lawrence freshwater ecosystem: a scientific and management tool

By Jean Morin, Marc Mingelbier and Jean-François Cantin

The water level regime in the freshwater portion of the St. Lawrence ecosystem is already subject to significant fluctuations. However, extreme water levels may occur in the coming decades, thanks to climate change. Under the biodiversity component of St. Lawrence Vision 2000, the water level subcommittee has tasked researchers with designing and validating models that describe the dynamics and ecosystem behaviour of the St. Lawrence and simulate a wide range of flow rates, water levels and currents. This work, by integrating our biological and physical knowledge of the St. Lawrence, will provide a better understanding of the effects of water level fluctuations on the St. Lawrence ecosystem and thus help us improve management methods.

The physical environment, a common denominator

The physical environment of the St. Lawrence is undoubtedly the common denominator for all of the projects undertaken by the water level subcommittee. Indeed, for the team to carry out its mandate, it must understand in detail the physics of the St. Lawrence. It is well known that the structure of plant and animal communities is governed by abiotic variables such as flow rate, water level, current, substrate, temperature and waves, and these factors explain much of the spatial and temporal variations in these communities. Such variables can be modelled fairly easily at a very high spatial resolution using two-dimensional mathematical models, as befits the river's great diversity and large spatial scale.

To quantify the effects of water level variations on the river system, the Canadian Meteorological Centre is modelling major abiotic variables such as water depth, currents and waves. This allows the value of physical variables to be predicted for the entire river with satisfactory accuracy, under all possible conditions, including conditions that have never been observed. The main advantage of modelling is that it minimizes the need for expensive systematic sampling, given that physical variables change spatially depending on flow rates and seasons. Modelling can also be used for a wide range of other applications, particularly for oil spills, a situation that calls for the ability to rapidly predict areas that may be impacted.

The link between GIS, mathematical simulations and field data

This river modelling work harnesses present computer and geographic information systems (GIS) technology along with mathematical models and extensive field data.

Digital tools developed by the Institut National de Recherche Scientifique-Eau, the Canadian Hydraulics Centre and several universities will be used for two-dimensional simulations of different water level, current, wave and light conditions between Montreal and Trois-Rivières. Based on the results obtained, variables—such as sediment dynamics, water mass distribution and residence time, and water temperature—can be simulated. The terrain model includes a high-resolution description of riverbed topography and the spatial distribution of substrate types and aquatic plants, which have an important effect on the physical environment.

Habitat-based ecosystem modelling

Living organisms are adapted to their environment, and their occurrence in the St. Lawrence, whether on the floodplain or the riverbed, is neither random nor fortuitous. Habitat preferences, which can be partially described by physical variables, explain in large part the presence of a species at a particular site. For example, sago pondweed, an abundant aquatic plant in the St. Lawrence, is only found in areas where the current ranges between 0.3 and 0.6 m/s and the luminous intensity is between 50% and 80% of incident light. Since modelling can provide the values for these variables anywhere in the St. Lawrence, it will be possible to predict this species' distribution in the river through its habitat preferences.

The notion of habitat can also be applied to human activities on the river, such as the "habitat" of a sailboat with a draft of 2 m or more. From predicted water levels, it will be possible to determine the areas where the sailboat can navigate.

The results of this work will be used to better understand the interactions between living organisms (or uses) and the physical environment. This will allow us to map the habitats of the St. Lawrence at a high spatial resolution, simulate situations that have not actually been observed and, in this way, assess the impact of water level fluctuations on the ecosystem.

Work in progress

A project undertaken by the Canadian Meteorological Centre to model the habitat of submerged aquatic plants is already well advanced. Currently, we are able to accurately predict the biomass of these plants in Lake Saint-François in 75% of cases and species composition, in 85% of cases. The Montreal-Sorel section of the river and Lake St. Pierre are also being studied.

In addition, the St. Lawrence Centre and the Canadian Meteorological Centre are working on modelling typical assemblages of emergent plants. The preliminary results are promising.

Lastly, the Société de la faune et des parcs du Québec, the Canadian Meteorological Centre and the St. Lawrence Centre are working on a model of fish habitats. Researchers are describing spawning, nursery and feeding areas for the main fish species in the St. Lawrence. The models will use information gleaned from over 120 documents, observations made in the river for the last 30 or more years and more and the results of scientific surveys.

Other ongoing modelling projects deal with erosion, sedimentation and primary production.

The integration and dissemination of knowledge

Such modelling projects are long-term efforts and will benefit from the additional knowledge acquired along the way. Ecosystem modelling is an ideal tool for integrating knowledge, since physical simulations require the linking of various terrain components. It is also a tool for disseminating knowledge, since results can be obtained in the form of still or animated images.

In the medium term, the modeling and integration tools developed will allow us to assess the effects of water level management, under various flow regime scenarios, on various biological components and uses in the St. Lawrence. Although computer ecosystem modelling is a highly powerful tool, it cannot predict everything and our knowledge of the links between abiotic and biotic components is still incomplete. Close cooperation between modellers and field researchers is therefore essential.

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Chronicle
ZIP Committees in the Heat of the Action

The Baie des Chaleurs, Îles de la Madeleine and Rive Nord de l'Estuaire ZIP committees

Promoting awareness of the health risks associated with mollusc consumption

Many residents of the estuary and Gulf of St. Lawrence are very fond of mollusc harvesting, a traditional activity practiced for generations. Harvesting practices that entail health risks have been observed, however. For this reason, over the past few weeks, the Baie des Chaleurs, Îles de la Madeleine and Rive Nord de l'Estuaire ZIP committees have been conducting public awareness campaigns on the issue, tailored to their regions and target audiences.

The recreational harvesting of molluscan shellfish—such as soft-shell and hard-shell clams, mussels and whelks—is undoubtedly one of the most popular traditional pursuits practiced in the many communities along the St Lawrence. Harvesters not only consider these foods to be delicacies but see the activity as a chance to keep an age-old tradition alive. In addition, in regions with significant unemployment, harvesting is an essential source of extra income for commercial harvesters.

Indeed, within the territories of the three ZIP committees (Chaleur Bay, the Magdalen Islands and the north shore of the estuary), several hundred people are regular s hellfish harvesters, while a variable number are casual or occasional gatherers (year-round and summer residents and tourists).

Good for your health… under certain conditions

Molluscs are a valuable food resource as well as an excellent source of protein, phosphorous, iodine and vitamins. They are also relatively low in cholesterol.

Unfortunately, harvesters sometimes engage in behaviour that may entail some health risks. Despite closure orders posted by Fisheries and Oceans Canada, some harvesters continue to harvest in areas that are closed due to the risk of microbial, chemical or toxic contamination. Possible reasons for this behaviour include an ignorance of the reasons for the closings and a lack of concern about the dangers linked to the consumption of contaminated shellfish.

"In our area, health problems in shellfish harvesting areas are linked mainly to the bacterial contamination of the water," explains Isabelle Hubert, of the Îles de la Madeleine (Magdalen Islands) ZIP Committee. "Most of this contamination can be attributed to sewage discharges from residences with substandard or malfunctioning septic systems and, to a lesser degree, to agricultural pollution."

The same situation is found in Chaleur Bay and along the north shore of the estuary.

A public awareness campaign tailored to regional needs and characteristics

To counter the risky behaviour sometimes observed among mollusc harvesters, Health Canada and the Quebec Department of Health and Social Services suggested to the Baie des Chaleurs, Îles de la Madeleine and Rive Nord de l'Estuaire ZIP committees that they develop public awareness campaigns. (Health Canada and the Quebec Department of Health and Social Services are partners in the Human Health component of the St. Lawrence Vision 2000 Plan). As Christiane Gagné, communications officer at Health Canada, explains, the committees went on to establish their own action plans based on the means at their disposal, the characteristics of their region and the target audience for the campaign. Representatives of Health Canada and Quebec's public health network then helped the committees to develop and validate the content of their plans.

The campaigns of the three ZIP committees had a number of common themes, such as the types of contamination that can affect molluscan shellfish, the symptoms associated with the consumption of contaminated molluscs and the assessment procedure that leads to the closure of shellfish harvesting areas. In some cases, an attempt was also made to counter widely held misconceptions, such as the belief that cooking can eliminate chemicals and toxins responsible for contamination.

For example, the Baie des Chaleurs ZIP Committee decided to produce several information spots for local

radio stations to reach its target audience. It also installed 13 information panels along the access roads to the most heavily frequented harvesting areas.

The Magdalen Islands committee, aside from with the above-mentioned measures, also had articles published in local newspapers and designed an information brochure. The brochure was distributed to islanders' households and made available to tourists through the regional tourist board (Association touristique régionale).

The Rive Nord de l'Estuaire ZIP Committee took a more direct approach. Representatives paid a visit to several harvesting areas to hand out brochures, memory joggers and fridge magnets to harvesters. The committee also organized information spots on local radio stations, had articles published in local newspapers, and held an information meeting to assist members of the regional tourist board in better informing tourists of the safety measures to be taken when harvesting or purchasing shellfish.

A substantial challenge to the public and economic health of riverside communities

In June, Human Health component partners held a workshop on the health risks associated with molluscan shellfish consumption. The Baie des Chaleurs, Îles de la Madeleine and Rive Nord de l'Estuaire ZIP committees took the opportunity to present some of the conclusions and recommendations that emerged from their respective public awareness campaigns. For example, many people believed that they were poorly informed of the reasons authorities used to close shellfish harvesting areas. Some harvesters were even skeptical about the actual health risks involved in eating contaminated shellfish. "Harvesters often told us that they had seen their grandparents eating molluscs without experiencing any health problems," explains Rachel Racine of the Rive Nord de l'Estuaire ZIP Committee. According to Racine, harvesting practices are so deeply rooted that additional action is needed to improve people's harvesting practices on a permanent basis.

Furthermore, representatives of the three ZIP committees stressed the importance of encouraging property owners with substandard septic systems to make the necessary improvements. This would allow shellfish harvesting zones closed due to bacterial contamination to be reopened. For example, Michel Chouinard, coordinator of the Baie des Chaleurs ZIP Committee, explained that, in his region, reopening closed harvesting areas could create a hundred or so jobs linked to commercial shellfish harvesting. Indeed, the prospect of economic development, including the possibility of mariculture, has led to the announcement of $2.2 million of investments in the region. This funding is earmarked to identify measures to eliminate the pollution sources that have led to the closure of 13 shellfish harvesting areas.

Lastly, many harvesters are worried about the shortcomings in conservation measures for molluscan shellfish stocks and are interested in actively participating in the management of shellfish areas. Accordingly, ZIP committee representatives have proposed that the departments involved adopt a co-management approach for molluscan shellfish harvesting, to include both coastal communities and regional authorities.

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News in BRIEF

Biodiversity portrait of the St. Lawrence

One of the primary objectives of the St. Lawrence Vision 2000 (SLV 2000) agreement is to describe biodiversity in the vast St. Lawrence River ecosystem. To achieve this, the two main partners in SLV 2000, Environment Canada and the Quebec Department of the Environment, have enlisted the services of their specialists to draw up an up-to-date portrait of biodiversity in the St. Lawrence. The report will be available on the SLV 2000 Web site in August. Don't miss it!

LE FLEUVE

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