Key Issues:
3- Fish Migration and River Navigation

Climate Zone:
Cf: Temperate

Subjects:
- Fishway

Chambly Dam on the Richelieu River

Effects:
- Allow upstream migration of juvenile American eel (*Anguilla rostrata*)

Project Name: Chambly Dam
Country: Canada

Implementing Party & Period
- Project: Hydro-Québec
1965
- Good Practice: Hydro-Québec
1997

Key Words:
American eel, ladder, fish migration, Chambly Dam

Abstract:
For 150 years, the Richelieu River (Québec, Canada) supported a sizable commercial silver American eel fishery. A sharp and constant decline of annual landings since 1981 has been at least partly related to the rebuilding, in 1965, of an old cribwork. In 1997, a ladder was retrofitted on the 270-m Chambly Dam to allow eel migration and enhance recruitment.

1. Outline of the Project

Chambly Dam is located on the Richelieu River, a tributary of the St. Lawrence near Montréal (Québec, Canada). It is a 270-m-long concrete overflow weir and the water head is approximately 5 m. It was built in 1965 to replace an old cribwork dam that was constructed in 1896.

2. Features of the Project Area

The Richelieu River drains Lake Champlain, a large lake bordering New York and Vermont states (USA) and extending into Québec. Lake Champlain is connected to the Hudson River and to the Great Lakes by a network of locks and canals. The Richelieu River extends for 115 km between Lake Champlain and the St. Lawrence River.

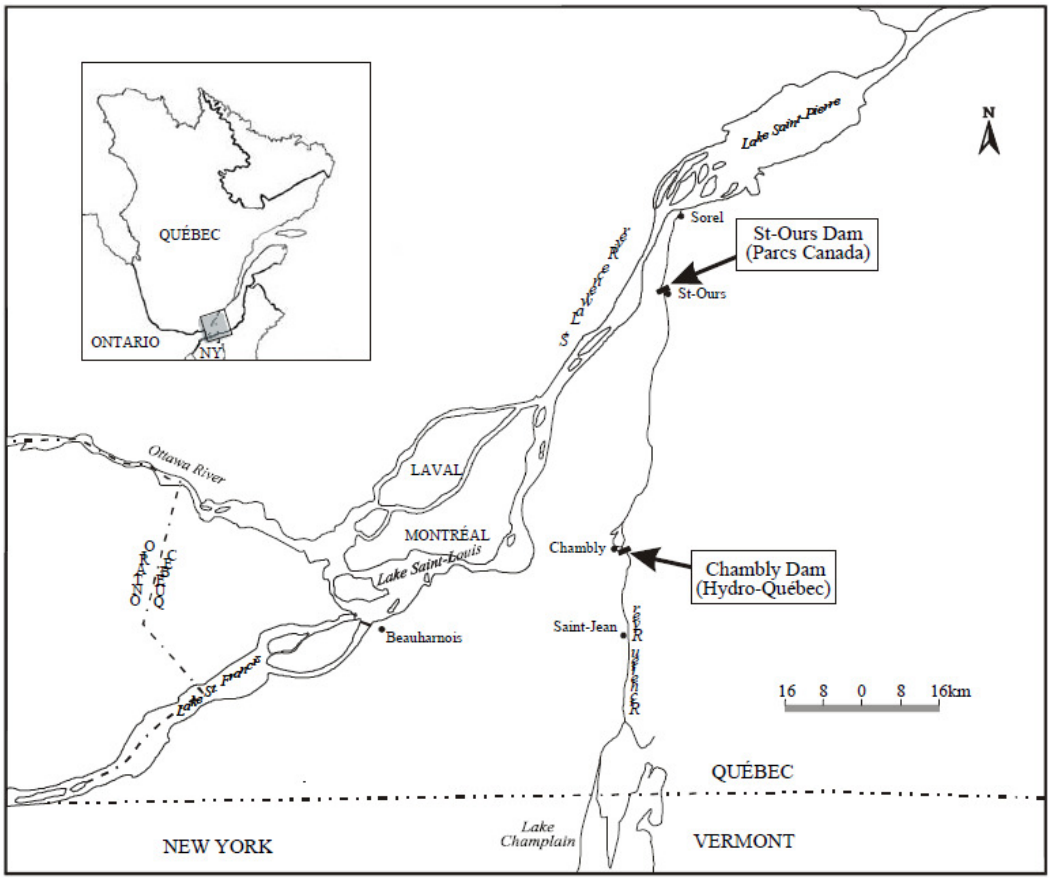

Figure 1 Location Map of the project

From June to September, the average discharge is 271 m3/s (1937-1996) or about 3.5% of the St. Lawrence River's flow at the confluence of the two rivers. Before the middle of the 19th century, no artificial barrier impeded fish migration in the Richelieu. Two cribwork dams were constructed along the Richelieu River, at Saint-Ours in 1846 and at Chambly, 52 km upstream, in 1896. The original structures were frequently damaged and were equipped with fishways that were not replaced when the dams were rebuilt, between 1965 and 1969. None of these dams are used for power generation. The Saint-Ours Dam is equipped with radial gates, and fish passage is possible for a few weeks during high discharge periods, typically in early spring. Recreational navigation locks allow boat passage around both dams and probably provide some upstream passage for a limited number of eels.

3. Major Impacts

For 150 years, the Richelieu River (Québec, Canada) supported a sizable commercial silver American eel fishery. Between 1920 and 1980, annual landings fluctuated from 0 (World War II) to 74.8 metric tons (1938), averaging 34.6 tons. A sharp and constant decline since 1981 (from 72.9 to 4.7 tons) and a significant increase in eel size (from 890 to 1,017 mm between 1987 and 1997) pointed to a decline in recruitment in the Lake Champlain watershed. Although a decline in the eel fishery has also been recorded in the rest of Québec, the decrease in the Richelieu watershed is more pronounced. This increased decline has been at least partly related to the rebuilding, in the 1960s, of two old cribwork

dams, Saint-Ours and Chambly. In 1998, the fishery stopped.

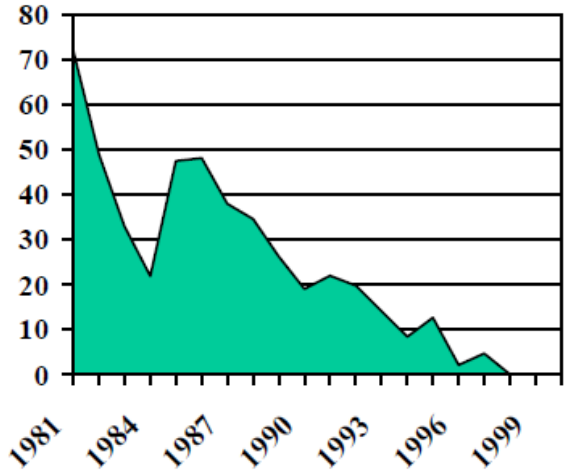

Figure 2 Annual eel landings (tons) in the Richelieu River from 1981 to 1999

4. Mitigation Measures

In 1997, a ladder was retrofitted on the Chambly Dam to enhance recruitment. For this purpose, a 12.6-m cutoff wall made of seven concrete blocks, each weighing 12 tons, was first installed on the weir crest, near the left river bank. This wall was necessary to stop the flow and create a relatively still area, allowing eels to swim to the foot of the dam. An eel ladder made of a wood and plastic climbing ramp, covered with staggered studs, was then fixed on the concrete wall and the down face of the dam. The ladder was 8.8-m long, 0.55 m wide, and had a slope of 51o. A submersible pump provided a flow of 0.6 L/s on the climbing ramp, while an additional attraction flow of 14.4 L/s was provided by gravity at the entrance. In 1998 and 1999, the design was improved by widening the entrance to 1.1 m and eliminating the leaks through the cutoff wall. In 1997 and 1998, a live trap at the ladder outlet captured the migrating eels, while a photoelectric counter was installed in 1999. At the outset, the electronic counts were validated with manual counts, and thereafter processed to eliminate false signals.

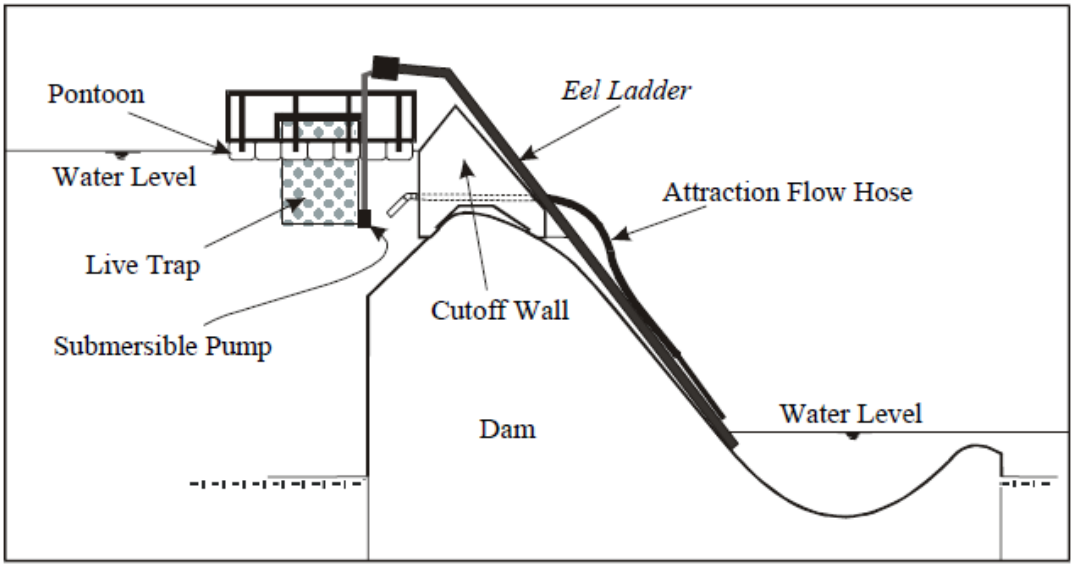

Figure 3 Cross-section of the eel ladder on the Chambly Dam

Figure 4 Photograph of the ladder

5. Results of the Mitigation Measures

The installation of an eel ladder in 1998 at Chambly allowed the upstream passage of eels that had been accumulating downstream from the dam over the preceding years. However, the number of eels ascending the ladder dropped from 9,875 in 1998 to 240 in 2002. This decrease is not related to a change in the efficiency of the ladder, but rather to a low recruitment related in part to a possible blockage at the Saint-Ours dam, 50 km downstream. This hypothesis is supported by the results of 2003 where 3,336 eels climbed the ladder, two years after the installation of a similar eel ladder at the Saint-Ours dam.

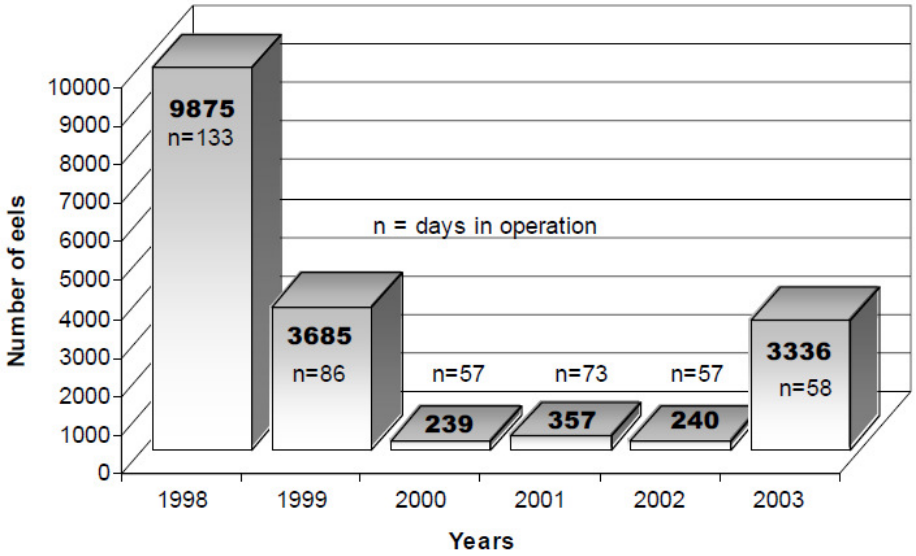

Figure 5 Number of eels that climbed the Chambly ladder from 1998 to 2003

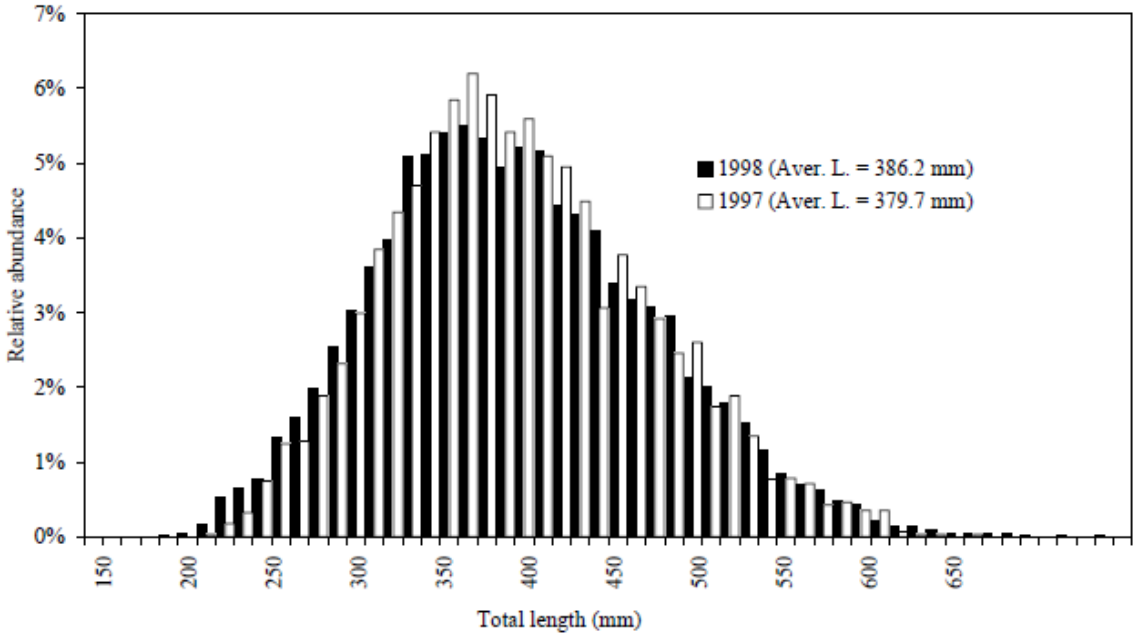

Figure 6 Length distribution of eels in the ladder in 1997 and 1998

6. Reasons for Success

Studies on eel migratory behavior and local distribution, prior to installation, resulted in optimal location of the ladder. In addition, testing eel climbing in different prototype ladders ensured improved efficiency of the structure. After initial installation of the ladder, monitoring of tagged eels during the following years led to efficiency assessment and further modifications. Improving the cutoff wall and widening the entrance led to increased efficiency.

7. Outside Comments

Positive comments on the efficiency of the ladder were received and a similar eel ladder was installed in 2001, by government agencies at the Saint-Ours dam, further downstream. In addition, in 2002 and 2003, one eel ladder and a eel trap of the same design have been installed at the Beauharnois power house (on the Saint-Lawrence) and more than 100 000 eels crossed over.

On the other hand, some negative comments were received for the Chambly installation because of the late installation, in some years, of the cutoff wall and the ladder, and the cutoff wall's unaesthetic appearance. In the fall of 2003, a permanent cut off wall was installed to solve these problems.

8. Further Information

8.1 References

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