Suivi de l'état du
SAINT-LAURENT

# St. Lawrence Estuary Beluga Whale

## Highlights

Status : poor in 2015-2020
Trend: Deteriorating since 20 Years

The St. Lawrence beluga population has been declining by about 1% per year since the early 2000s. Abnormally high mortality rates in newborns and pregnant females adversely affect current and future recruitment to the population. A parallel decline in belugas' physical condition suggests that some environmental factors are having a negative impact on feeding. Less abundant food sources, elevated levels of contamination, and chronic exposure to underwater noise and ships' traffic could be at issue.

## Problem

The beluga is an Arctic species, with the St. Lawrence population located in the southernmost part of its range. Designated Endangered, it is protected in Canada under the *Species at Risk Act*.

The beluga occurs primarily in the St. Lawrence Estuary and seasonally in the Gulf of St. Lawrence. This population, which was decimated in the early 20$^{th}$ century by commercial hunting and population reduction programs aimed at protecting commercial fish stocks, consisted of only around 900 individuals in 2012. Its current distribution area represents roughly 65% of the area that was occupied in the 1930s.

Several non-exclusive, and possibly cumulative, factors could hinder the population's recovery. Disturbance and collision risks from pleasure boats, chronic noise from shipping traffic, and the presence of toxic chemical substances in the environment are a few examples. Warmer water and air temperatures and poorer ice conditions (extent and duration of ice cover) than in the 1990s, which became extreme after 2010, have coincided with a decrease in individual survival and recruitment and a roughly 1% annual decline in the size of the population.

The role that these potentially adverse factors play in the population's decline remains uncertain. However, recent observations indicate that the various protection measures implemented since 1986 and the conservation plans developed over the years have been insufficient to ensure the population's recovery (DFO 2018).

## Study area

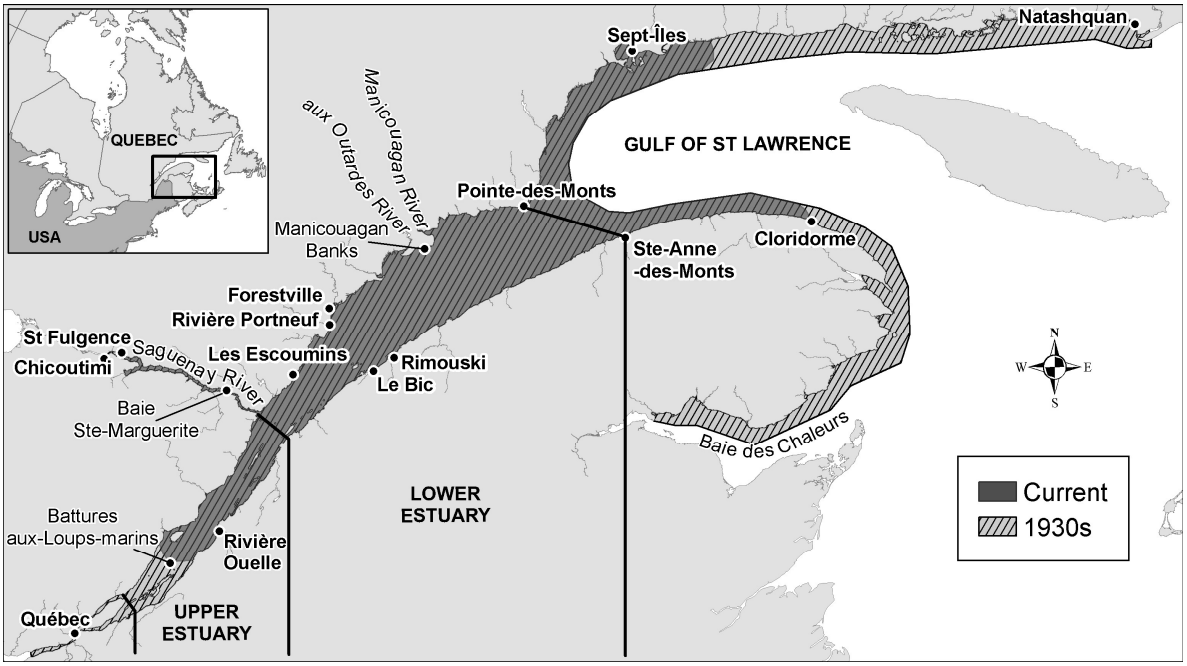


Figure 1. Current and historical (1930s) distribution of St. Lawrence beluga whale

## Key measures

Aerial photographic surveys, conducted by Fisheries and Oceans Canada, provide abundance indices for assessing the status of the St. Lawrence Estuary beluga population. Correction factors are used in order to consider the area not covered by the survey and the animals diving.

The carcass monitoring program, in place since 1983, provides mortality indices according to age structure. Beluga carcasses, depending on their state of decomposition, are sampled on site or sent to the Université de Montréal's Faculty of Veterinary Medicine for a complete necropsy. Pathologists take various samples to determine the cause of mortality (e.g., infectious disease, cancer, trauma).

Carcass samples are subjected to a variety of analyses, such as determining changes in diet using chemical tracers or the degree of contamination by persistent and toxic organic compounds (PCBs, DDT, Mirex, PBDEs).

The size of the St. Lawrence beluga population is estimated using a population dynamics model, which is used to integrate information specific to this population into a biologically realistic framework for the species, i.e. abundance indices and percentage of juveniles estimated by aerial surveys, as well as mortality indices estimated by the carcass monitoring program.

# Status and trends

### Population trends and dynamics

Estimates of abundance and the proportion of calves (0-1 years) in the population are determined from aerial surveys, for which the same sampling plan has been used since 1988. Mortality indices by age and sex class are calculated from the results of a carcass monitoring program, in place since 1983.

A modelling approach, which integrates these estimates in a biologically realistic framework, has revealed a population decline and a significant shift in population dynamics beginning around 2000. From 1999 until at least 2012 (the last year of modelling), greater variability was found in newborn mortalities and female fecundity. Modelling also showed a decreasing proportion of juveniles in the population and a roughly 1% annual decrease in total numbers. An independent study providing annual estimates of the proportion of newborns and juveniles in the population since 1989 has corroborated the results of this model.

In 2012, the number of belugas in the St. Lawrence was estimated to be 900 individuals. A new aerial survey conducted in 2019 will allow the results of the model to be updated.

## Carcass monitoring and causes of death

Necropsies performed on 222 carcasses from 1983 to 2012 indicate that infectious diseases are the main cause of mortality in this population, affecting 72% of juveniles and 32% of individuals found dead. Cancer caused the death of 20% of adults. However, none of the belugas born after 1971 had cancer, the year the regulations were enacted to control many chemicals such as PAHs and PCBs. Calving problems were responsible for 19% of adult female mortality. The occurrence of these problems increased during the 2000s.

The carcass monitoring program shows that total mortality (number of dead belugas found) remained stable until at least 2007, despite some interannual variations. Subsequently, trends in certain age and sex classes began to emerge. During 11 out of the 13 past years, the number of newborns found dead has exceeded the maximum numbers recorded from 1983 to 2007. Conversely, the number of carcasses of adult males found annually has declined, a trend that likely began in the mid-1990, while the those of adult females and juveniles have remained stable.

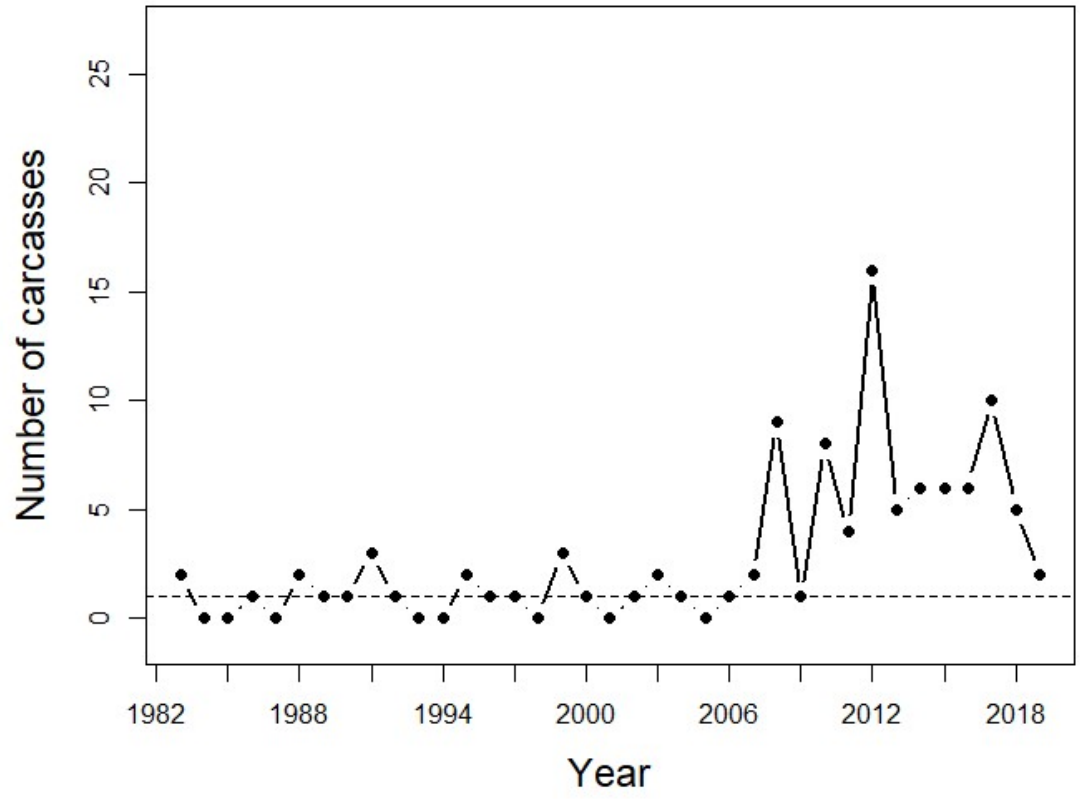


Figure 2. Annual reports of dead newborn calves in the Estuary and Gulf of St. Lawrence, 1983-2019. The dashed horizontal lines represent the median of the time series.

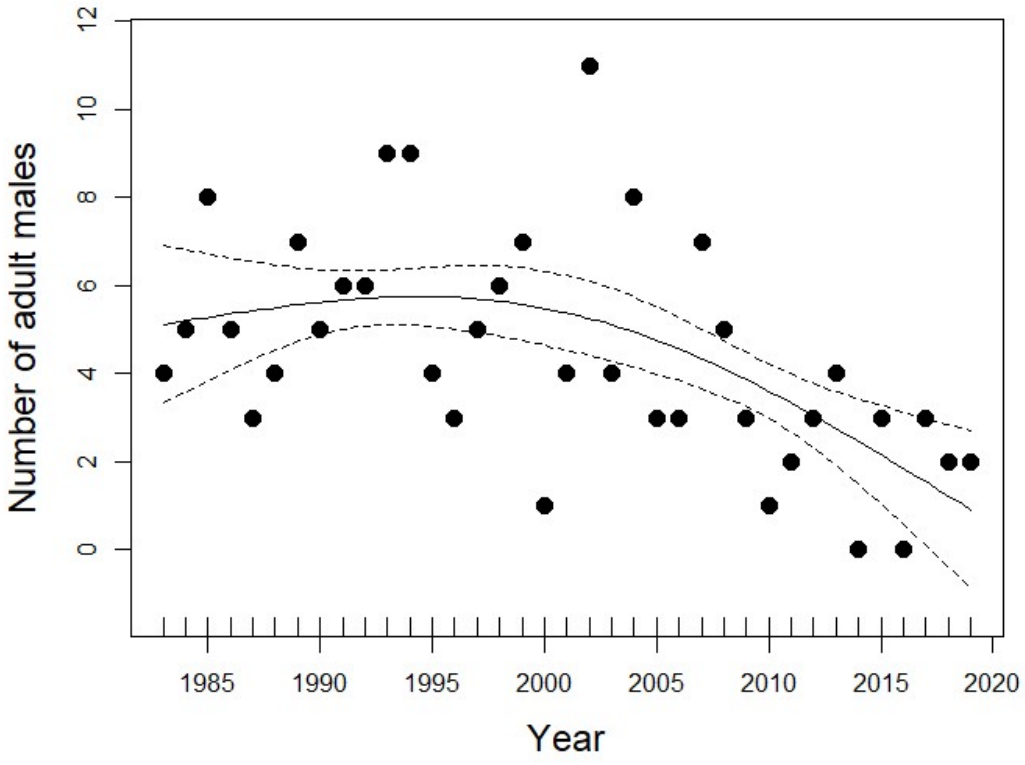


Figure 3. Annual number of adult male beluga carcasses reported in the St. Lawrence Estuary and Gulf from 1983 to 2019 (solid circle), and predicted downward trend since 1995 (curve with 95% confidence interval).

These differences in mortality in the population could have multiple explanations. Males could be less detectable due to a change in distribution or could be less abundant or less exposed to stressors. Another possible explanation is that female and male survival have improved as a result of such things as regulations pertaining to contaminants. However, in females, the recent trend of greater mortality during calving may have cancelled out the benefits of decreased mortality from cancer, and could explain the increased mortality in newborns.

A decline in the physical condition of St. Lawrence belugas was also documented in the 2000s, which suggests problems with obtaining an adequate diet.

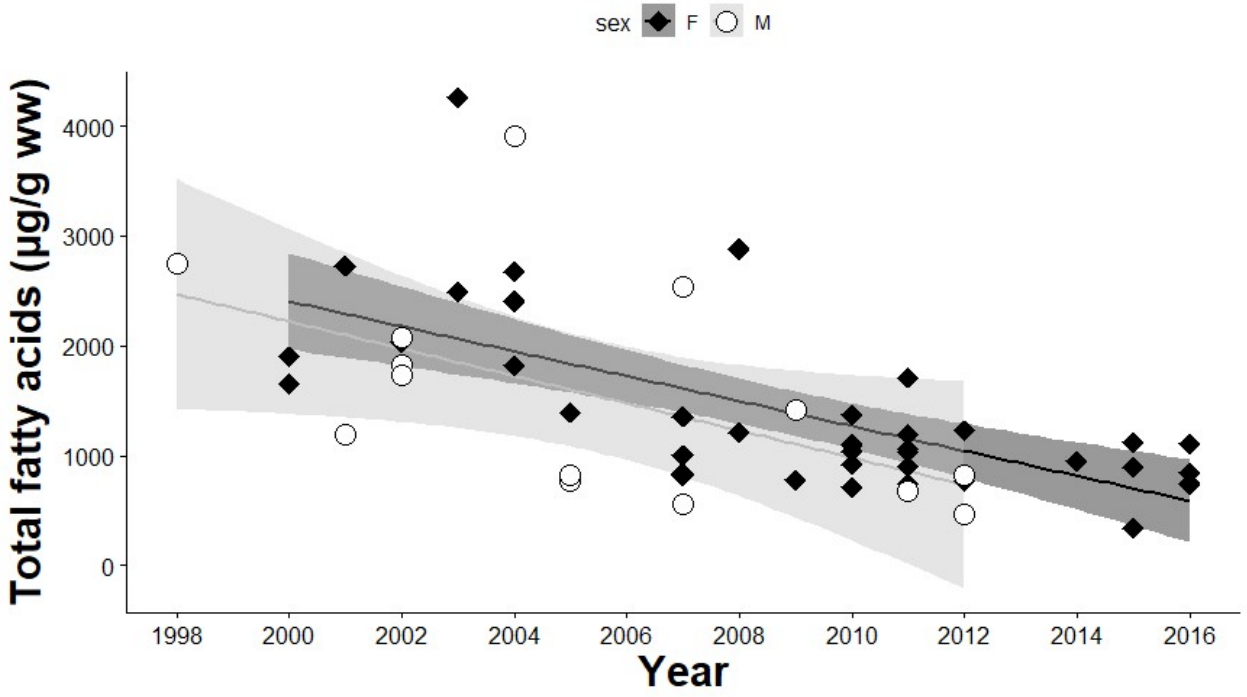


Figure 4. Index of physical condition (quantity of fatty acids in the blubber - µg/g wet weight) in adult males (solid circle) and adult females (empty circle), and predicted downward trend between 1998 and 2016 (curve with 95% confidence interval).

## Potential stressor

Several hypotheses have been proposed to explain the increased mortality in newborns and adult females and the demographic changes; these factors are not exclusive and may be cumulative.

Even though the concentrations of some pollutants like PCBs and DDT have decreased in belugas in the last decade, those of new chemical substances, particularly PBDEs, flame retardants, increased exponentially in their tissues in the 1990s. Although there is no current evidence of hypothyroidism in St. Lawrence belugas associated with PBDEs, a correlation has been found between concentrations of some emergent flame retardants and the expression of certain thyroid genes in the population. However, the increase in mortality in newborns and young females (late 2000s) does not coincide with the peak in PBDE concentrations in belugas (1998), which raises doubts about the importance of the role of these pollutants in recently observed mortalities.

St. Lawrence belugas also suffer form chronic exposure to noise from commercial shipping and ferries operating in their habitat. From May to October, they are also exposed to whale watching by pleasure boating and to a large tourist industry targeting them in certain areas.

These activities disturb belugas by altering or masking their vocalizations and by reducing the area where the whales can communicate with and hear each other. They are also likely to disrupt the acoustic connection between mothers and their newborns, interrupt critical activities like calving and nursing, and interfere with foraging. The deterioration in belugas' physical condition in the 2000s is likely nutritional in origin, possibly explained by a decrease in prey abundance or quality. However, under these circumstances, interference or noise from vessel traffic that hinders foraging, or poor health resulting from the adverse effects of contaminants, could act as aggravating factors.

The shift in the dynamics of the beluga population at the turn of the 21st century coincides with profound changes in oceanographic conditions in the Estuary and Gulf of St. Lawrence. This ecosystem, characterized by relatively cold air and water temperatures and harsh winters prior to 2000, experienced warmer conditions in the 2000s, which have intensified since 2010. These changes occurred simultaneously with the collapse of the stocks of some of the beluga's key prey species, without this loss in biomass being replaced by that of other species. The impacts of these changes have been noted on the reproduction of several species of marine mammals, including the beluga.

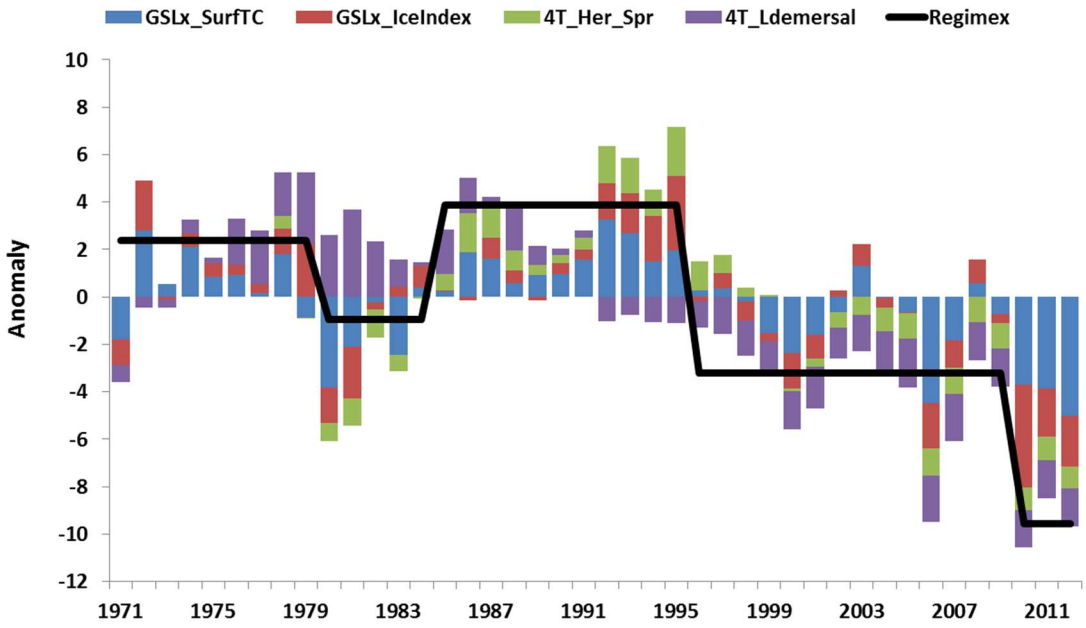


Figure 5. Changes in physical and biological conditions potentially important to St. Lawrence Estuary beluga habitat from 1971 to 2012. Stacked bar: annual anomalies in terms of physical conditions (surface temperature, ice index) and potential food sources (Southern Gulf of St. Lawrence spring herring and large demersal fish). Black line: Different periods separated by shifts derived from an analysis performed on the sum of all environmental anomalies. Note that the time series of Southern Gulf of St. Lawrence herring begins in 1978 and that negative temperature and ice index anomalies have generally continued until 2020.

Toxic algal blooms can also cause high mortalities. This phenomenon, which occurred in 2008, resulted in large numbers of deaths among St. Lawrence belugas as well as other species.

## Outlook

The inability of the beluga population to recover despite the ban on hunting suggests that anthropogenic and/or environmental stressors were already restricting its growth in the 1980s and 1990s.

Belugas have been living in the St. Lawrence for 10,000 years and are well adapted to an extreme and ever-changing environment. However, the speed of climate warming, the population's isolation, and cultural traits that make it less able to colonize new areas could reduce its ability to adapt to change. Although its diet is varied, the beluga seems to be largely dependent on key prey species at certain times of the year.

The regulation of certain toxic chemical substances seems to have paid off by reducing cancers. However, the vulnerabilities described above, and the decline in belugas' physical condition, underline the urgency of taking additional measures, which must be effective. Continuing research and monitoring efforts will allow the effectiveness of the actions taken to be measured and the factors involved to be more accurately identified.

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**State of the St. Lawrence Monitoring Program**

Five government partners—Environment and Climate Change Canada; Fisheries and Oceans Canada; Parks Canada; the Ministère de l'Environnement et de la Lutte contre les changements climatiques du Québec; and the Ministère des Forêts, de la Faune et des Parcs du Québec—and Stratégies Saint-Laurent, a non-governmental 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 the long-term trends affecting it.

For more information about the State of the St. Lawrence Monitoring Program, please visit our website: http://planstlaurent.qc.ca/en/state_monitoring.html.

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