COSEWIC
Assessment and Status Report

on the

Beluga Whale
Delphinapterus leucas

St. Lawrence Estuary population

in Canada

ENDANGERED
2014

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Pippard, L. 1983. COSEWIC status report on the beluga whale *Delphinapterus leucas* (St. Lawrence River population) in Canada. Committee on the Status of Endangered Widlife in Canada. Ottawa. 46 pp.

Finley, K.J., J.P. Hickie and R.A. Davis. 1985. COSEWIC status report on the beluga whale *Delphinapterus leucas* (Beaufort Sea/Arctic Ocean population) in Canada. Committee on the Status of Endangered Widlife in Canada. Ottawa. 24 pp.

Reeves, R.R. and E. Mitchell. 1988. COSEWIC status report on the beluga whale *Delphinapterus leucas* (Eastern Hudson Bay population) in Canada. Committee on the Status of Endangered Widlife in Canada. Ottawa. 60 pp.

Reeves, R.R. and E. Mitchell. 1988. COSEWIC status report on the beluga whale *Delphinapterus leucas* (Ungava Bay population) in Canada. Committee on the Status of Endangered Widlife in Canada. Ottawa. 60 pp.

Richard, P.R. 1990. COSEWIC status report on the beluga whale *Delphinapterus leucas* (Southeast Baffin Island/Cumberland Sound population) in Canada. Committee on the Status of Endangered Widlife in Canada. Ottawa. 29 pp.

Doidge, D.W. and K.J. Finley. 1992. COSEWIC status report on the beluga whale *Delphinapterus leucas* (Eastern High Arctic/Baffin Bay population) in Canada. Committee on the Status of Endangered Widlife in Canada. Ottawa. 45 pp.

Richard, P. 1993. COSEWIC status report on the beluga whale *Delphinapterus leucas* (Western Hudson Bay population) in Canada. Committee on the Status of Endangered Widlife in Canada. Ottawa. 27 pp.

Lesage, V. and M.C.S. Kingsley. 1997. Update COSEWIC status report on the beluga whale *Delphinapterus leucas* (St. Lawrence River population) in Canada. Committee on the Status of Endangered Widlife in Canada. Ottawa. 31 pp.

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COSEWIC
Assessment Summary

Assessment Summary – November 2014

Common name
Beluga Whale - St. Lawrence Estuary population

Scientific name
Delphinapterus leucas

Status
Endangered

Reason for designation
This population, endemic to Canada, is at the southernmost limit of the species' distribution, and is reproductively and geographically isolated from other populations. This population of a long-lived, slowly reproducing species was severely reduced by hunting, which continued until 1979. Since population monitoring surveys began in the 1980s, the total population size has remained at around 1000 individuals -- less than 20% of the population size in the late 1800s or early 1900s. The major threats currently affecting this population include pathogens, toxic algal blooms, pollution, noise disturbance, and other human intrusions and disturbance. The impacts of these threats are likely amplified by the low number of mature individuals remaining in the population. Since the mid-2000s, the population has shown evidence of major demographic changes including increased neonate mortality and a decline in the proportion of young individuals in the population. These trends, together with past and ongoing habitat degradation, and projected increases in threats, suggest that the status of this population has worsened and is at considerably greater risk than when it was previously assessed by COSEWIC in 2004.

Occurrence
Quebec, Atlantic Ocean

Status history
Designated Endangered in April 1983. Status re-examined and confirmed in April 1997. Status re-examined and designated Threatened in May 2004. Status re-examined and designated Endangered in November 2014.

COSEWIC
Executive Summary

Beluga Whale
Delphinapterus leucas

St. Lawrence Estuary population

Wildlife Species Description and Significance

Beluga Whales (*Delphinapterus leucas*) are medium-sized toothed whales. They are born grey, and gradually become paler with maturity - adults are completely white. A primarily Arctic species, the Beluga is the only representative of its genus. The population in the St. Lawrence Estuary (SLE) is at the southernmost limit of the species' global distribution.

Distribution

In Canada, seven populations of Belugas have traditionally been recognized, based on disjunct summer distributions and genetic differences: 1) SLE, 2) Ungava Bay, 3) Eastern Hudson Bay, 4) Western Hudson Bay, 5) Eastern High Arctic–Baffin Bay, 6) Cumberland Sound, and 7) Eastern Beaufort Sea. Several of the Arctic populations mix during spring and autumn migrations and share common wintering areas.

SLE Belugas occur in the Estuary during the summer and shift eastward into the north-western Gulf of St. Lawrence during the fall and winter. Their winter distribution does not overlap that of any of the Arctic populations.

Habitat

The timing and extent of seasonal movements are likely influenced primarily by sea ice, food availability, and predation risk. Spring is an important feeding period.

Spatial segregation by sex and age occurs, at least during the summer. Females accompanied by calves and juveniles aggregate mostly in the shallower, warmer, less saline, and more turbid waters of the Upper Estuary. Adult males concentrate in the deeper, colder, and more saline waters of the northern portion of the Lower Estuary.

Estuarine aggregation is typical of the species. The whales may depend on estuarine habitat for feeding, calving and nursing, skin moulting, and predator avoidance. The southern channel of the Upper Estuary resembles the shallow, relatively warm areas often associated with Beluga aggregations in other regions.

Habitat quality has declined over the past several decades, primarily as a result of the large volume of vessel traffic, chronic discharge of various chemical substances, fishing activities, changes in environmental conditions, and recurrent toxic algal blooms.

Biology

Belugas have mean life spans of 30–60 years (some individuals may live beyond age 70) and attain sexual maturity at 6–7 years. Most conceptions occur between April and June. Females give birth to one calf every 3 years on average. Reproductive output appears to have changed recently, with a decline in the proportion of immature individuals and other major changes in demography of the population since the late 1990s.

Belugas exhibit strong site fidelity to summering sites and estuaries, which render them vulnerable to site-specific anthropogenic threats. They occupy a relatively high trophic level and feed on a variety of fishes and invertebrates.

Population Size and Trends

The SLE Beluga population was reduced by intensive hunting. It probably numbered between 5,000 and 10,000 in the late 1800s but only approximately 1,000 in the 1980s when regular monitoring began. Numbers remained stable or increased slightly once the population was protected from hunting, but since the early 2000s it has declined slowly, with an estimated total population of 889 (95%CI 672-1167) in 2012. There was a model-estimated 10-year decline of 12.6% in the total population between 2002 and 2012. Reasons for this decline are not understood. The population model indicated 2293 mature individuals in 1934 (3 generations of 26 years) and 3168 in 1922 (3 generations of 30 years). This suggests that there was a 75% to 82% decline in mature individuals over the last 3 generations (78-90 years) with a model-derived estimate of 583 mature individuals in 2012.

Threats and Limiting Factors

SLE Belugas live downstream of a densely populated, highly industrialized part of North America. Chemical and biological contamination, as well as the loss and perturbation of habitat, are continuing threats. Toxic spills, harmful algal blooms, and epizootic diseases can lead to numerous deaths over short time scales (days or weeks).

SLE Belugas live in a much more temperate environment than those in the Arctic. As the climate changes, higher water temperatures and reduced ice cover may affect these animals indirectly in a number of ways (e.g., less shelter from storms during the winter, altered ecosystem structure leading to greater interspecific competition, novel pathogens, and more exposure to expanding human activities).

Protection, Status, and Ranks

SLE Belugas have been protected from hunting under the Marine Mammal Regulations of the *Fisheries Act* since 1979. The population was assessed by COSEWIC as Endangered in 1983 due to the decline in numbers caused by overhunting; COSEWIC confirmed this status in 1996. In 2004 COSEWIC assessed this DU as Threatened and it was listed as such on Schedule 1 of the Canadian *Species at Risk Act* in May 2005, and under the Québec *Loi sur les espèces menacées et vulnérables* (RLRQ, c E-12.01) (LEMV) (Act respecting threatened or vulnerable species) (CQLR, c E-12.01) (MRNF 2011), in March 2000. Most recently, COSEWIC assessed the status of the SLE Beluga Whale as Endangered in 2014. Globally, the Beluga (species level) is red-listed as Near Threatened. The general status of Belugas in Canada is secure according to Wild Species and NatureServe. The SLE Beluga population has a NatureServe status of Critically Imperilled, or at a high risk of extirpation. It currently receives special protection from harassment under regulations governing activities at sea in the Saguenay–St. Lawrence Marine Park, which is under both provincial and federal jurisdictions. Proposed critical habitat was finalized in 2012 and corresponds to the area occupied in summer by females accompanied by calves and juveniles. Legal protection of the critical habitat under SARA is pending.

TECHNICAL SUMMARY

Delphinapterus leucas

Beluga Whale — Béluga

St. Lawrence Estuary population — Population de l'estuaire du Saint-Laurent

Range of occurrence: Québec, Atlantic Ocean (Estuary and northwestern Gulf of St. Lawrence)

Demographic Information

Generation time (usually average age of parents in the population; indicate if another method of estimating generation time indicated in the IUCN guidelines(2008) is being used) Assumes 1 dentinal growth layer group per year (Stewart et al. 2006).	26-30 years
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals? There is an inferred and projected continuing decline in number of mature individuals.	Yes
Estimated percent of continuing decline in total number of mature individuals within [5 years or 2 generations] (52-60 years)	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over the last [10 years, or 3 generations] (78-90 years) A population model incorporating, among other things, data on catches of Belugas between 1913 and 1960, indicated that there were 2,293 mature individuals in 1934 (3 generations of 26 years = 78 years) and 3,168 in 1922 (3 generations of 30 years = 90 years); assuming 580 mature individuals in 2012 as estimated from the model, the number declined by 75% to 82% over the last 3 generations (78-90 years).	75% to 82%
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next [10 years, or 3 generations] (78-90 years). A future decline is expected due to the recent high mortality rate of neonates. The threats calculator analysis produced an overall threat impact of “medium” to “very high”. “Very high” indicates that the population may experience a 50% to 100% (Median 75%) population reduction over the next 10 years.	Unknown
[Observed, estimated, inferred or suspected] percent [reduction or increase] in total number of mature individuals over any [10 years, or 3 generations] period, over a time period including both the past and the future. A population model including, among other things, data on catches of Belugas between 1913 and 1960, indicated that there were 1440 mature individuals in 1937 (3 generations of 26 years) and 2163 mature individuals in 1925 (3 generations of 30 years). Assuming 583 mature individuals in 2012 and with a future decline expected, this means that a 60% to 82% decline in mature individuals can be inferred over a 3-generation time period (78-90 years) including both the past and the future.	60% to 82%

Are the causes of the decline clearly reversible and understood and ceased? Some but not all major causes are understood; some apparently have not ceased and may not be reversible; multiple threats remain; new and emergent threats have been identified.	No
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence Taken from COSEWIC (2004)	~36,000 km^2
Index of area of occupancy (IAO, 2 x 2 km^2 grid values) IAO: 20,628 km^2 Summer IAO: 5,664 km^2 Summer critical habitat: 3,216 km^2	Summer critical habitat: 3,216 km^2
Is the population severely fragmented?	No
Number of locations	1
Is there an observed continuing decline in extent of occurrence?	No
Is there an observed continuing decline in index of area of occupancy? (Current Area of Occupancy is 65% of historical; see Figure 4)	No
Is there an [observed, inferred, or projected] continuing decline in number of populations?	No
Is there an [observed, inferred, or projected] continuing decline in number of locations?	No
Is there an [observed, inferred, or projected] continuing decline in quality of habitat? Habitat degradation through shoreline projects (e.g., construction of harbour infrastructure, hydroelectric development) Contaminants from local and distant sources Anthropogenic noise (e.g., marine traffic, underwater construction)	Yes
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals

Population	N Mature Individuals
Total SLE Population: 583 is the number of mature individuals in 2012 representing 66% of the total population according to the Bayesian population model.	583 (95% C.I.: 444, 770)

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years].	Analysis not conducted

Threats (actual or imminent, to populations or habitats)

Current: Habitat loss and degradation affects the Beluga population both directly and indirectly. St. Lawrence Estuary Belugas are also threatened by chemical and biological contamination, anthropogenic noise and disturbance, climate variability and its effects on food availability, inbreeding, resource competition with commercial fisheries, fishing gear entanglement, strikes by small vessels, harmful algal blooms (sporadically), infections and parasitic diseases, and chronic contamination by toxic substances introduced by heavy marine traffic. Imminent: Degradation and loss of critical habitat through coastal development and increased vessel traffic. Epizootic diseases represent a suspected threat or limiting factor.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? Status of Beluga DUs in eastern Canada varies from Endangered to Special Concern. The species is red-listed by IUCN as Near Threatened.	
Is immigration known or possible? Genetic analyses indicate that there is no mixing of this DU with other Canadian Beluga DUs.	Unlikely
Would immigrants be adapted to survive in the SLE?	Unknown
Is there sufficient habitat for immigrants in the SLE? Current decline may be associated with a decrease in quantity or quality of available habitat.	Unknown
Is rescue from outside populations likely?	No

Data-Sensitive Species

Is this a data-sensitive species?	No

Status History

COSEWIC: Designated Endangered in April 1983. Status re-examined and confirmed in April 1997. Status re-examined and designated Threatened in May 2004. Status re-examined and designated Endangered in November 2014.

Status and Reasons for Designation:

Status: Endangered	**Alpha-numeric code**: A2abce+4abce; C2a(ii)
Reasons for designation: This population, endemic to Canada, is at the southernmost limit of the species' distribution, and is reproductively and geographically isolated from other populations. This population of a long-lived, slowly reproducing species was severely reduced by hunting, which continued until 1979. Since population monitoring surveys began in the 1980s, the total population size has remained at around 1000 individuals—less than 20% of the population size in the late 1800s or early 1900s. The major threats currently affecting this population include pathogens, toxic algal blooms, pollution, noise disturbance, and other human intrusions and disturbance. The impacts of these threats are likely amplified by the low number of mature individuals remaining in the population. Since the mid-2000s, the population has shown evidence of major demographic changes including increased neonate mortality and a decline in the proportion of young individuals in the population. These trends, together with past and ongoing habitat degradation, and projected increases in threats, suggest that the status of this population has worsened and is at considerably greater risk than when it was previously assessed by COSEWIC in 2004.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Meets Endangered A2abce, with an estimated decline in mature individuals of 75% or 82% over the past 3 generations (78 and 90 years, respectively) based on direct observation of the disappearance of Belugas from a formerly important part of their habitat (Manicouagan Bank (a), an index of historical vs. current abundance (Bayesian model-derived) (subcriterion b), a documented reduction in IAO and quality of habitat (subcriterion c), and effects of pathogens and pollutants (subcriterion e). Causes of the reduction may not have ceased, are not understood, and may not be reversible. Also meets A4abce.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. Extent of occurrence and area of occupancy exceed thresholds.
Criterion C (Small and Declining Number of Mature Individuals): Meets Endangered C2a(ii) with < 2500 mature individuals, continuing decline in number of mature individuals is inferred based on increased numbers of beach-cast calves, documented decline in young individuals as a proportion of the population and consequent expected decline in recruitment, and all mature individuals are in a single population. Threats assessment provides an overall threat impact in a range from medium to very high. This suggests a potential decline up to 75% of the population in the next 10 years.
Criterion D (Very Small or Restricted Population): Meets Threatened D1, with an estimated 583 (95% CI: 444, 770) mature individuals.
Criterion E (Quantitative Analysis): No applicable analyses conducted.

PREFACE

The St. Lawrence Estuary (SLE) Beluga Whale was assessed by COSEWIC as Threatened in 2004. At that time, abundance estimates (corrected for bias) indicated a larger population than previously thought (Kingsley 2002). An updated Recovery Strategy was published in 2012, identifying this population's critical habitat, specifying the most serious threats to the population, and presenting a schedule of mitigation actions to achieve objectives related to population size and distribution (DFO 2012).

Despite the implementation of several programs to protect habitat and reduce anthropogenic impacts in its core distribution area, the SLE Beluga population has not increased since the last assessment (DFO 2014a). In fact, recent analyses indicate that the population has declined over the past 10 years, and has experienced changes in vital rates and age structure. The population appears to have moved from a relatively stable to an unstable period characterized by an apparent shift from a 3-year calving cycle to a 2-year cycle, increased variability in neonate mortality and pregnancy rates, and a decline in the proportion of immature individuals and newborns in the population.

The documented changes in population dynamics and demographic characteristics occurred during a period of changing environmental conditions in the Gulf of St. Lawrence, concomitant with high levels of some contaminants in Beluga tissues, chronic and increasing exposure to noise and recreational activities, and sporadic toxic algal blooms in the SLE.

There has been an important change in scientific understanding of Belugas since the last COSEWIC assessment. The previous scientific consensus was that Belugas are exceptional among the toothed cetaceans in that they form two rather than one dentinal growth layers in their teeth annually. These layers (referred to as Growth Layer Groups, or GLGs; Perrin and Myrick 1980) are used for age estimation and their interpretation has a major influence on estimates of life history parameters including generation time. After a period of controversy (e.g., see Sergeant 1959; Brodie 1969; Goren *et al.* 1987; Brodie *et al.* 1990, 2013; Heide-Jørgensen *et al.* 1994; Stewart *et al.* 2006; Lockyer *et al.* 2007), it has now been generally accepted that only one GLG is formed annually (NAMMCO 2012). This has the effect of doubling the generation time from 13-15 years (average of 14 years; COSEWIC 2004) to 26-30 years in this report.

The Marine Mammals Subcommittee has commissioned a separate report on Beluga designatable units (DUs) but that report is not expected to be available in completed form until at least the fall of 2015 (possibly later), after which the species (all DUs) throughout Canada will be reassessed. However, an unsolicited status report on the SLE DU was received in May, 2014, leading the Subcommittee to proceed with reassessment of this DU in 2014.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2014)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment Canada / Environnement Canada
Canadian Wildlife Service / Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

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Beluga Whale
Delphinapterus leucas

St. Lawrence Estuary population

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2014

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Table 1. Beluga abundance in the SLE estimated from photographic aerial surveys (n=8) and visual line transect surveys (n=28) flown between 1988 and 2009. Abundance indices are corrected for animals not visible at the surface (Table from DFO 2014a). 30

Table 2. Primary causes of death in SLE Belugas from 1983 to 2012 ordered by diagnostic category and by age group (Table from Lair *et al.* 2014). 34

WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

The Beluga Whale, *Delphinapterus leucas* (Pallas, 1776) (Figure 1), derives its English common name from belukha in Russian meaning white. *Delphinus* is Latin for dolphin and *pteron* (Ancient Greek) means fin or wing, thus apteron refers to the lack of a dorsal fin. The other often-used English vernacular name is white whale. Béluga is the common name in French although marsouin blanc or baleine blanche have also been used. The Beluga is the only species in its genus; it and the Narwhal, *Monodon monoceros*, comprise the family Monodontidae (Rice 1998).

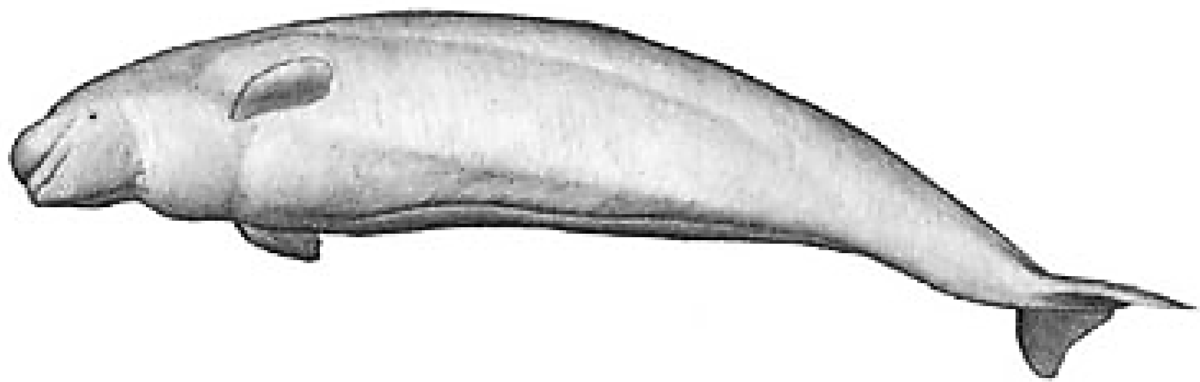

Figure 1. Illustration of the Beluga, *Delphinapterus leucas*, by G. Kuehl.

Morphological Description

Belugas are toothed whales with a rounded head, broad flippers, and no dorsal fin. They are the only cetacean with unfused cervical vertebrae, allowing unusual flexibility of the neck and head (Stewart and Stewart 1989).

Newborn Belugas are dark grey or brown and become lighter with age. Transition to uniformly white occurs at 10-20 years of age, assuming one growth layer group (GLG) per year is deposited in tooth dentine (Stewart *et al.* 2006). This transition does not always coincide with sexual maturity.

Belugas are about 1.5 m long at birth (48% the length of their mothers), and adult lengths range from 2.6 to 4.5 m depending on the population, with adult females being approximately 80% the length of adult males (reviewed in Lesage *et al.* 2014b). SLE Belugas are of medium size compared to other populations in Canada (Sergeant and Brodie 1969), with average adult lengths of 3.6 m for females and 4.2 m for males, which are reached approximately 5 years later in males than females (Lesage *et al.* 2014b).

Population Spatial Structure and Variability

When last assessed by COSEWIC in 2004, seven populations were recognized as DUs (Figure 2): (1) St. Lawrence Estuary (SLE), (2) Ungava Bay, (3) Eastern Hudson Bay, (4) Western Hudson Bay, (5) Eastern High Arctic–Baffin Bay, (6) Cumberland Sound, and (7) Eastern Beaufort Sea. Recent studies indicate that there may be more population structure than currently recognized, although these studies would not alter previous conclusions regarding SLE Belugas (Richard 2010; Postma *et al.* 2012).

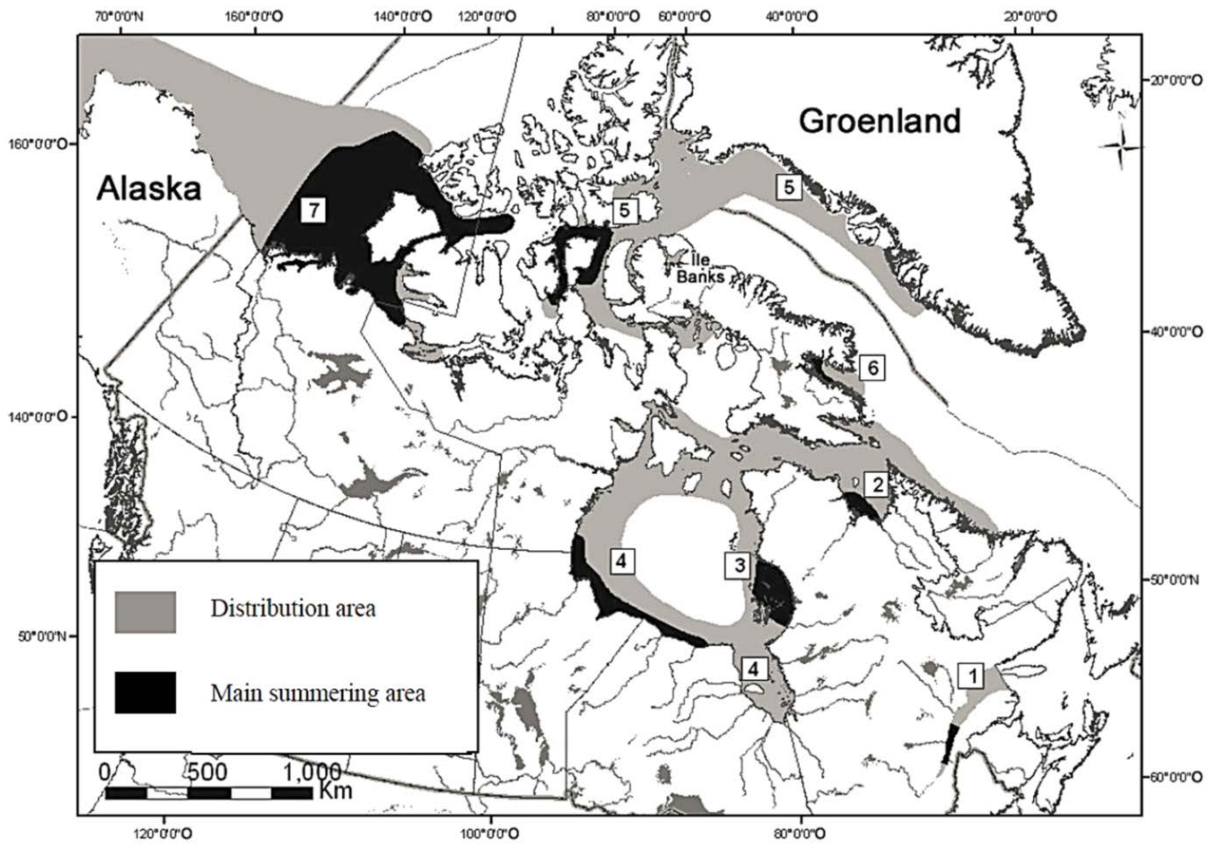

Figure 2. Location of the Canadian Beluga populations: 1) St. Lawrence Estuary population, 2) Ungava Bay population, 3) Eastern Hudson Bay population 4) Western Hudson Bay population, 5) Eastern High Arctic – Baffin Bay population, 6) Cumberland Sound population, 7) Eastern Beaufort Sea population (Figure from DFO 2012, which was adapted from COSEWIC 2004).

Beluga population spatial structure in Canada has been defined primarily according to the location of summer aggregations, but also according to behavioural, morphometric and genetic characteristics (COSEWIC 2004). Spatial structure has also been examined by reference to the timing and routes of migration of satellite-tracked whales (Martin *et al.* 1993; Smith *et al.* 2007; Bailleul *et al.* 2012), traditional knowledge obtained from Inuit communities (Hammill and Lesage 2009; Lewis *et al.* 2009), contaminant levels (Innes *et al.* 2002b), and a combination of isotopic signatures and trace elements (Rioux *et al.* 2012).

Mitochondrial DNA (mtDNA) analyses revealed two assemblages of Belugas in North America that are geographically disjunct, one in the SLE and eastern Hudson Bay and the other consisting of the rest of the summering populations (Brennin *et al.* 1997; Brown Gladden *et al.* 1997; Postma *et al.* 2012). Taking account of populations in Svalbard and Russia (O'Corry-Crowe *et al.* 2010), Belugas appear to have undertaken a postglacial recolonization from two different refugia, followed by isolation and limited dispersal over evolutionary timescales.

Behavioural and molecular genetic studies indicate a high degree of philopatry to summer aggregation areas (Caron and Smith 1990; Smith *et al.* 1994; Colbeck *et al.* 2013). Fall, winter, and spring distributions are contiguous or overlapping for some of the populations in the Arctic (Brown Gladden *et al.* 1999a; de March *et al.* 2002; de March and Postma 2003; COSEWIC 2004) but there is no evidence to suggest that the distribution of SLE Belugas significantly overlaps that of any other population at any season.

Designatable Units

The previous status report on Belugas in Canada divided the species into seven designatable units (DUs) (COSEWIC 2004). There is compelling evidence for considering the SLE population to be discrete and evolutionarily significant. Also, this population exists in an ecological setting that is unusual, if not unique, for the species, and local adaptations are likely, although not defined with certainty. It therefore qualifies as a DU.

Fossil remains suggest that Belugas became established in the St. Lawrence area during the Wisconsin glaciation, about 10,000 years ago (Harington 1977, 2008). Molecular genetic studies indicate that the population most closely related to SLE Belugas is in eastern Hudson Bay, and the two populations have been isolated from the others over evolutionary timescales (Brennin *et al.* 1997; Brown Gladden *et al.* 1997; O'Corry-Crowe *et al.* 2010; de March and Postma 2003; Postma *et al.* 2012). SLE Belugas are differentiated from all other Canadian Beluga populations by both mtDNA haplotypes and microsatellites (Brown Gladden *et al.* 1997, 1999a; de March and Postma 2003). The St. Lawrence Beluga is the most genetically divergent population of Belugas in Canada based on both nuclear and mitochondrial markers, with average pairwise nuclear and mitochondrial differentiation (FST) of 0.083 and 0.41, respectively (de March and Postma 2003). Two of the three mtDNA haplotypes found in SLE Belugas are unique to their population (Brown Gladden *et al.* 1997). A very low level of genetic exchange is thought to be sufficient to increase genetic variability in the absence of strong selection (Crow and Kimura 1970). The low nuclear genetic diversity observed in SLE Belugas is similar to that observed in other isolated, insular populations of mammals (de March and Postma 2003; Patenaude *et al.* 1994), and suggests that contributions from neighbouring populations are insignificant.

SLE Belugas undertake seasonal movements, as do most other Beluga populations, but the extent of such movements appears to be limited to the northwestern Gulf of St. Lawrence (Mosnier *et al.* 2010). The winter distribution of eastern Hudson Bay Belugas extends into the Labrador Sea, but only to several hundreds of kilometres north of the Gulf of St. Lawrence (Bailleul *et al.* 2012). Small numbers of Belugas have been observed along the north shore of the St. Lawrence and south coast of Labrador and off Newfoundland (Vladykov 1944; Reeves and Katona 1980; Reeves and Mitchell 1984; Pippard 1985b; Sergeant 1986; Michaud and Chadenet 1990; Curren and Lien 1998; Kingsley and Reeves 1998; Benjamins and Ledwell 2009). However, significant ongoing immigration is considered unlikely given that the nearest populations in Ungava Bay, Hudson Bay, and West Greenland are depleted (Smith and Hammill 1986; Reeves and Mitchell 1989; Richard 1991, 1993; Hammill *et al.* 2009). The low genetic diversity observed in the SLE Belugas further suggests that immigration from neighbouring populations is unlikely.

A recent study analyzing genetic variation at 13 microsatellite loci indicates that Belugas maintain associations with close relatives during migration, a behaviour which could facilitate learning of migration routes (Colbeck *et al.* 2013). This cultural conservatism may impede recolonization of extirpated summering areas and limit dispersal between stocks that use different migration routes (Colbeck *et al.* 2013). Evidence for this scenario comes from, among other places, the Mucalic River (Ungava Bay), Great Whale River and Nowliapik River (eastern Hudson Bay) and probably Manicouagan Bank, which Belugas appear to have abandoned in the wake of extensive hunting and hydroelectric development in north shore rivers flowing into the SLE (Sergeant and Brodie 1975; Reeves and Mitchell 1987; Sergeant and Hoek 1988; Hammill *et al.* 2004).

Aboriginal traditional knowledge regarding Belugas in the St. Lawrence estuary is limited. There is some archaeological evidence of Beluga harvest by Iroquois hunters, and an account of hunters travelling with Jacques Cartier, who mentioned that they hunted Belugas in the river (Tremblay 1993). The available Aboriginal traditional knowledge appears to support other sources of information that the SLE Beluga population is distinct from other populations.

Special Significance

The Beluga is the only species of its genus and is one of only two species in the family Monodontidae, the other being the Narwhal. Belugas are found only in Arctic and sub-Arctic latitudes of the northern hemisphere (Stewart and Stewart 1989). The SLE Beluga population lives at the southernmost limit of the species' northern circumpolar distribution. This population and the population in Cook Inlet, Alaska, are more exposed than others to chronic anthropogenic stressors such as chemical and biological contaminants, noise, algal toxins, and infectious and parasitic diseases (Martineau 2012). As such, their study may advance understanding of the effects of marine development in more pristine Arctic areas (Fox 2001).

The SLE Beluga population has social and economic importance primarily in the form of whale-watching tourism, as it is the only population of this species in North America that is easily accessible to the public. In Québec, SLE Belugas are, along with the Peregrine Falcon (*Falco peregrinus*), the icon for the conservation of species at risk, protection of the St. Lawrence and biodiversity. Concerns over the future of SLE Belugas were a determining factor leading to the establishment, in 1998, of the Saguenay-St. Lawrence Marine Park, jointly managed by the federal and provincial governments.

DISTRIBUTION

Global Range

Belugas have a discontinuous circumpolar distribution, inhabiting Arctic and sub-Arctic waters of North America and Eurasia (Figure 3) (Stewart and Stewart 1989; Reeves 1990). Their range extends south to 60°N in the Pacific and 47°N in the Atlantic, including the SLE (Sergeant 1962; Ivashin and Mineev 1981; Laidre *et al.* 2000).

The International Whaling Commission's (IWC) Scientific Committee has divided the global Beluga population into 29 putative stocks, or provisional management units (IWC 2000), totalling well over 150,000 animals (Jefferson *et al.* 2012). Some of these management units are of unknown size. Several of them have distinct geographical ranges during the summer months but mix during spring and autumn migrations and share common wintering areas.

Canadian Range

Belugas are distributed in the western Arctic (Beaufort Sea), high Arctic (Lancaster Sound, Baffin Bay), eastern Arctic (Cumberland Sound and elsewhere off southeastern Baffin Island), Hudson Bay, James Bay, Ungava Bay, and the SLE (COSEWIC 2004). The SLE and Cumberland Sound populations appear to have a smaller seasonal range than other Canadian populations, with distribution shifting only tens to a few hundred kilometres from their summer range (Richard 2010).

Beluga summer distribution in the SLE is centred at the outflow of the Saguenay River, between Battures aux Loups Marins and Rivière Portneuf on the north shore of the SLE, Rimouski on the south shore of the SLE, and to Baie-Sainte-Marguerite in the Saguenay River (Figure 4). The distribution range of Beluga varies seasonally but seldom extends west of Battures aux Loups Marins, or east of Sept-Îles (north shore of the SLE) or Cloridorme (on the Gaspé Peninsula). Occasional observations occur in Baie-des-Chaleurs, and up to Saint-Fulgence in the Saguenay River (Mosnier *et al.* 2010).

Figure 3. Global distribution of Belugas, *Delphinapterus leucas.* The species is found in the waters of Alaska, Canada, Greenland, Norway, and Russia (Figure from DFO 2012, adapted from Reeves 1990).

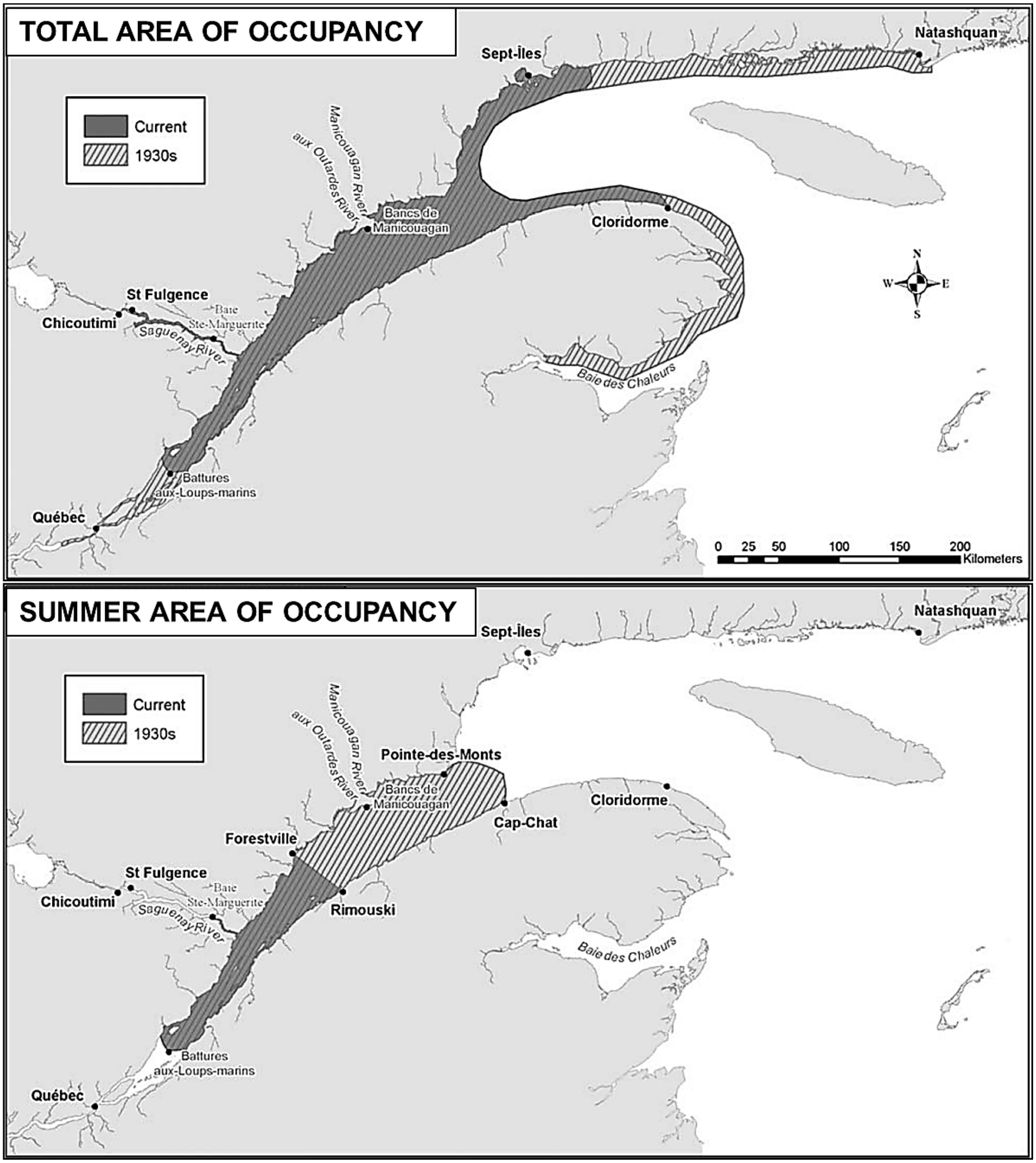

Figure 4. Historical (1930s) and current area of occupancy (total and summer) of the SLE Beluga population (Figure from Mosnier *et al.* 2010).

Extent of Occurrence and Area of Occupancy

The extent of occurrence is ~36,000 km^2 (COSEWIC 2004).

The index area of occupancy (IAO; using 2 x 2 km grid values) is estimated at 20,628 km^2 (Figure 4 upper panel). The summer IAO is estimated at 5,664 km^2. When considering the most limiting or vulnerable life history stage, i.e., calving females, the IAO would be reduced to 3,216 km^2, which corresponds to the critical habitat of the population (Figure 5), or the area occupied by females accompanied by calves and juveniles during summer (June-October) (DFO 2012).

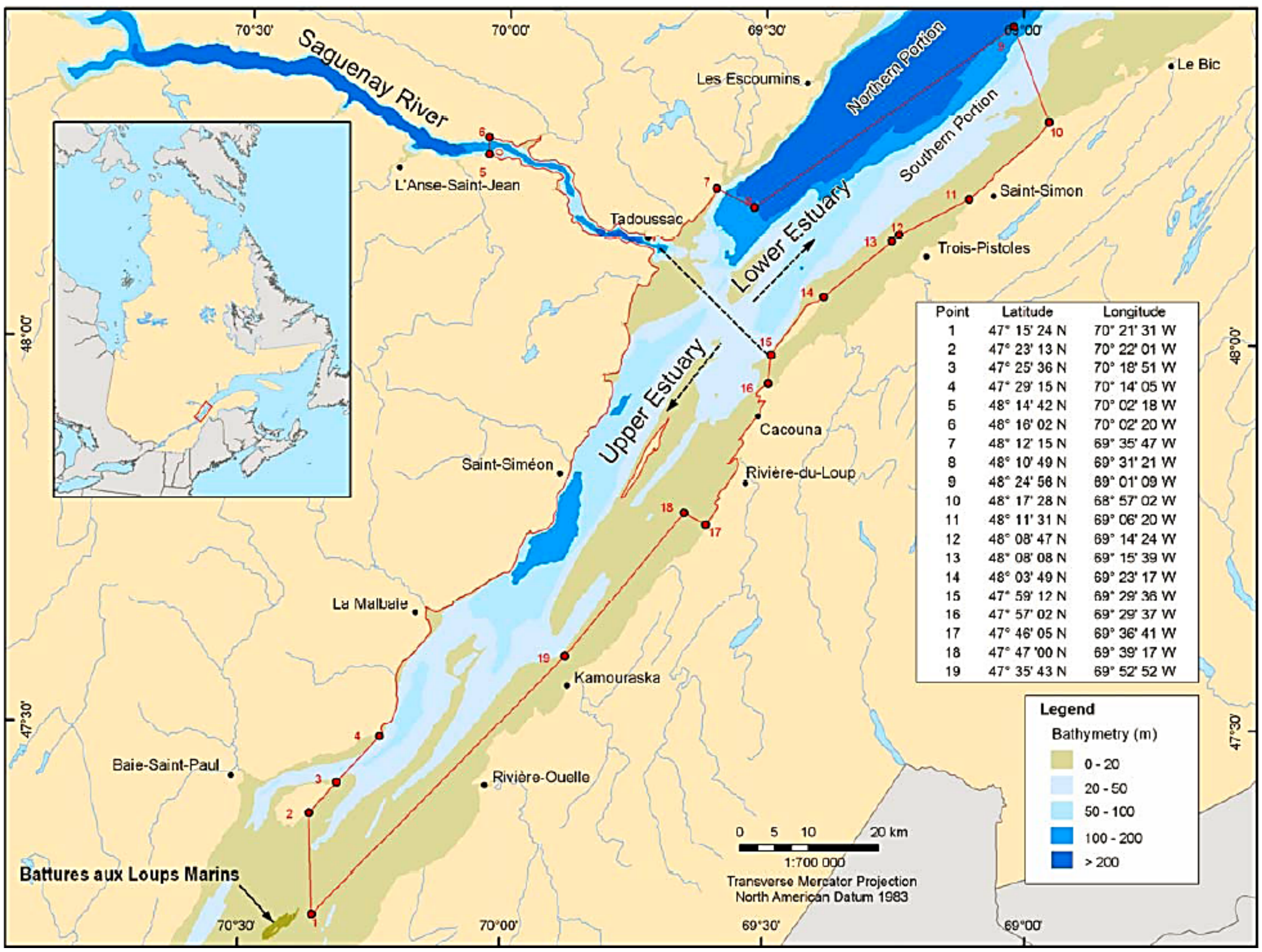

Figure 5. Critical habitat of the SLE Beluga population (red polygon). The 19 geographical points delineating the critical habitat are shown on the right. The area extends from Battures aux Loups Marins to just north of Saint-Simon, and includes the lower section of the Saguenay River. Inset: the location of the sector in Québec (Figure from DFO 2012).

The current area of occupancy of SLE Belugas (i.e., $20{,}628\ \mathrm{km}^2$) is a fraction (ca. 65%) of their historical area of occupancy using 1938 as the reference year. Whether this range contraction has resulted from reduced population size, habitat loss or both is unknown. A similar range contraction, thought to be associated with population decline, has been observed in the small, isolated Beluga population of Cook Inlet, Alaska over the past 30 years (Rugh *et al.* 2010). Habitat alteration resulting from the damming of the Manicouagan and Outardes Rivers in the 1960s, in combination with over-hunting in this area, may be responsible for the disappearance of Belugas from that part of their historical range (Vladykov 1944; Pippard and Malcolm 1978; Sergeant and Brodie 1975; Laurin 1982; Reeves and Mitchell 1984; Pippard 1985a; Michaud *et al.* 1990).

Recent observations suggest a possible range expansion of Belugas to the east of what has come to be viewed as their regular summer distribution, notably between Rimouski and Pointe-des-Monts (Michaud 1993; Kingsley 1996; Kingsley and Reeves 1998; Lawson and Gosselin 2009). Vladykov (1944) had recognized this as an area of Beluga summer occurrence during the 1930s. There has been negligible survey effort in summer between Rimouski and Pointe-des-Monts to investigate whether the whales are expanding their range into this formerly significant area (Mosnier *et al.* 2010).

Search Effort

Since 1973, there has been considerable effort to estimate abundance and characterize the distribution of SLE Belugas. Thirty-six systematic aerial surveys conducted in summer between 1988 and 2009 are in the process of being summarized by DFO researchers (A. Mosnier and J.-F. Gosselin).

The vast majority of the studies of SLE Beluga distribution and abundance have been conducted in the summer (Pippard and Malcolm 1978; Pippard 1985a; Sergeant 1986; Béland *et al.* 1987; Sergeant and Hoek 1988; Kingsley and Hammill 1991; Kingsley 1993, 1996, 1998, 1999; Michaud 1993; Gosselin *et al.* 2007, 2014). Several survey techniques and platforms have been employed, including systematic and non-systematic designs using marine vessels, helicopters, and airplanes. Since 1988, systematic strip transect aerial photographic surveys have been used as the standard method to investigate abundance (Kingsley 2002). Starting in 2003, multiple replicate visual aerial surveys following a line-transect design were also flown annually in an attempt to reduce survey costs and uncertainty around abundance estimates. These surveys covered the entire known summer distribution, and were conducted at the same period each year (late August to early September), providing continuous and comparable data on Beluga summer distribution and estimates of population size (see **POPULATION SIZES AND TRENDS** section).

Information on Beluga distribution outside the summer period is based on a limited number of studies and surveys, several of which followed a non-systematic design. Fall distribution was assessed with two visual aerial surveys conducted in mid-October and November 1989 covering the entire SLE (Boivin and INESL 1990). Winter distribution is based on 12 visual aerial surveys or patrols with variable coverage, conducted from December to March (Sears and Williamson 1982; Boivin and INESL 1990). Four of these surveys followed a systematic transect design and covered the entire SLE (Boivin and INESL 1990; Michaud *et al.* 1990). The only data on Beluga spring distribution comes from anecdotal reports and two visual aerial surveys conducted over the SLE in late April and early June 1990 (Michaud and Chadenet 1990).

The earlier surveys in the St. Lawrence were part of a process to refine search techniques for better population estimates. Consequently, there is ambiguity in how some of the estimates from the early years (pre-1988) were obtained as well as differences in methodology, which limits their value in the analysis of population trends (Michaud and Béland 2001).

Most of the effort to estimate Beluga abundance and characterize their distribution in the SLE has been restricted to the summer season, and to areas of known and regular occurrence. While survey lines were added over the years at the eastern and western extremities of the summer range, few studies have extended much beyond these limits. The two most systematic efforts, which covered the entire SLE and a large part of the Gulf of St. Lawrence, confirmed that the population is generally restricted to the zone frequently surveyed in the summer. However, 17 sightings totalling 27 Belugas downstream of the assumed summer distribution in July 2007 (i.e., one month earlier than the regular surveys (Lawson and Gosselin 2009)), raised questions as to the current limits of the distribution. Since then, summer surveys have included an additional set of transects to the east, but no Belugas were seen in this zone during the 2009 survey (Gosselin *et al.* 2014).

HABITAT

Habitat Requirements

The type of habitat used by Belugas varies seasonally, and can range from ice-free and estuarine to coastal and offshore ice-covered marine environments (Moore *et al.* 2000; Barber *et al.* 2001; Suydam *et al.* 2001; Lydersen *et al.* 2002). During summer, they tend to concentrate in shallow estuaries (Vladykov 1944; Sergeant 1973; Smith and Martin 1994; Moore *et al.* 2000) or in other relatively warm environments where surface water temperatures can reach 15–17°C (St. Aubin *et al.* 1990; Smith and Martin 1994; Boily 1995), but they can also occur offshore and in waters several hundreds of metres deep (Martin and Smith 1992; Heide-Jørgensen *et al.* 1998; Kingsley *et al.* 2001; Boltunov and Belikov 2002; Innes *et al.* 2002a; Lewis *et al.* 2009). Life processes associated with estuary occupancy may include calving and nursing, breeding, feeding, skin moulting, and predator avoidance (Tomilin 1967; Kleinenberg *et al.* 1969; Fraker *et al.* 1979; Finley 1982; Doidge 1990; Frost and Lowry 1990; St. Aubin *et al.* 1990; Watts *et al.* 1991; Boily 1995; Richard *et al.* 2001).

Habitat requirements also vary according to age, sex, size and reproductive status and may be modulated by energy requirements and survival strategies (Michaud 2005; Loseto *et al.* 2006). Spatial segregation of age- and sex-classes is typical for Belugas during the summer (Michaud 1993; Smith *et al.* 1994; Smith and Martin 1994; Heide-Jørgensen and Lockyer 2001; Michaud 2005; Loseto *et al.* 2006, 2008). Generally, small-sized individuals, including females nursing calves, tend to remain closer to shore or in shallower waters, while large individuals tend to remain in deeper or more offshore waters (Vladykov 1944; Smith and Martin 1994; Richard *et al.* 1997). Whether spatial segregation by sex- and age-class is maintained outside the summer season is unclear, although there is some evidence, from Belugas harvested in the same location and on the same day, to indicate that social groups composed of females and their relatives (i.e., related genetically) stay together during the spring and fall migrations (Colbeck *et al.* 2013).

In the St. Lawrence ecosystem, sub-Arctic conditions (cold, productive waters and seasonal ice cover), and substantial freshwater input from several sources, notably the Saguenay, aux Outardes, and Manicouagan Rivers, have favoured the continued presence of Belugas at these low latitudes (El-Sabh and Silverberg 1990).

The summer distribution of Belugas in these waters varies with age and sex: 1) females accompanied by calves and juveniles aggregate in the Upper Estuary, between the Battures aux Loups Marins and the Saguenay River, in relatively shallow, warm, turbid, and brackish waters; 2) large white adults, presumably males, aggregate in the deeper, colder and more saline waters of the Laurentian Channel in the northern Lower Estuary, where females with calves and juveniles are seldom observed during summer; and 3) mixed herds, composed of white adults, adults with calves and juveniles, or both, gather in an intermediate sector encompassing the Saguenay River, the head of the Laurentian channel and the southern section of the Lower Estuary east almost to St-Fabien (Michaud 1993).

The critical habitat of SLE Belugas for the period of June to October has been defined based on areas of high usage or concentration (Figure 5) (Pippard and Malcolm 1978; Michaud 1993; Lemieux *et al.* 2012), and corresponds to the concentration areas of females, calves and juveniles (Figure 6). Data are currently too scarce to define critical habitat for other seasons. Habitat features considered essential for Beluga vital functions include food availability, the oceanographic processes leading to the upwelling of cold mineral-rich and productive waters, a suitable acoustic environment, and shallow waters (DFO 2012).

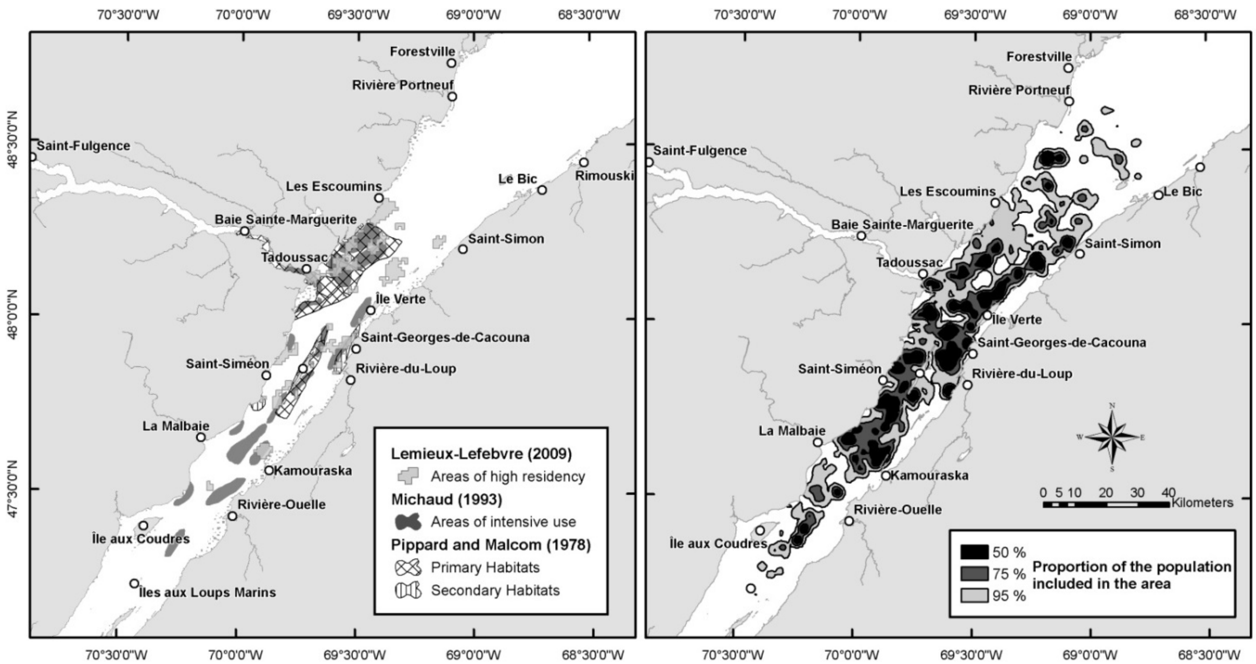

Figure 6. Areas of concentration within the summer distribution area of SLE Belugas documented by three studies conducted over a decade apart (left), and the proportion of the population included in these areas of concentration (right) (Figure from Mosnier and Gosselin unpubl. data).

Beluga individual home ranges and site fidelity in the SLE are not well understood, thus the degree of connectivity among areas of high residency as well as the degree of habitat fragmentation, must be resolved. Belugas have been observed crossing large parts of their summer range several times per day, suggesting various sites are visited sequentially by individuals, possibly using specific travel routes (Pippard and Malcolm 1978; Pippard 1985a; Michaud 1992; Chadenet 1997; Lemieux Lefebvre *et al.* 2012).

Habitat Trends

The St. Lawrence River and Estuary comprise a major commercial seaway to interior North America, with over 7400 transits by large merchant ships a year, twice as many whale-watching transits over the summer period, variable activity by a few thousand pleasure boats, and tens of thousands of transits each year by ferries providing daily service crossing the SLE and the mouth of the Saguenay River (Ménard *et al.* 2014; Som 2007). Maritime shipping routes along the North Shore, as well as the vast majority of the whale-watching activity, currently overlap the Belugas' summer distribution and part of their critical habitat (Figure 7) (Lesage *et al.* 2014a; Ménard *et al.* 2014). The at-sea whale-watching industry nearly tripled its activity between 1993 and 2003 (Ménard *et al.* 2014). An increase in certain types of navigational activities was also documented in specific portions of the SLE Beluga critical habitat between 2003 and 2012 (Ménard *et al.* 2014). While commercial shipping and ferry activities have been relatively constant over the past decade, an increasing interest in developing Québec's natural resources or exporting Canadian products may lead, in the short to medium term, to increased maritime traffic in the St. Lawrence Seaway. All of these ongoing and future activities, in combination, can be expected to contribute to acoustic habitat degradation for SLE Belugas (Clark *et al.* 2009; Jensen *et al.* 2009; Gervaise *et al.* 2012).

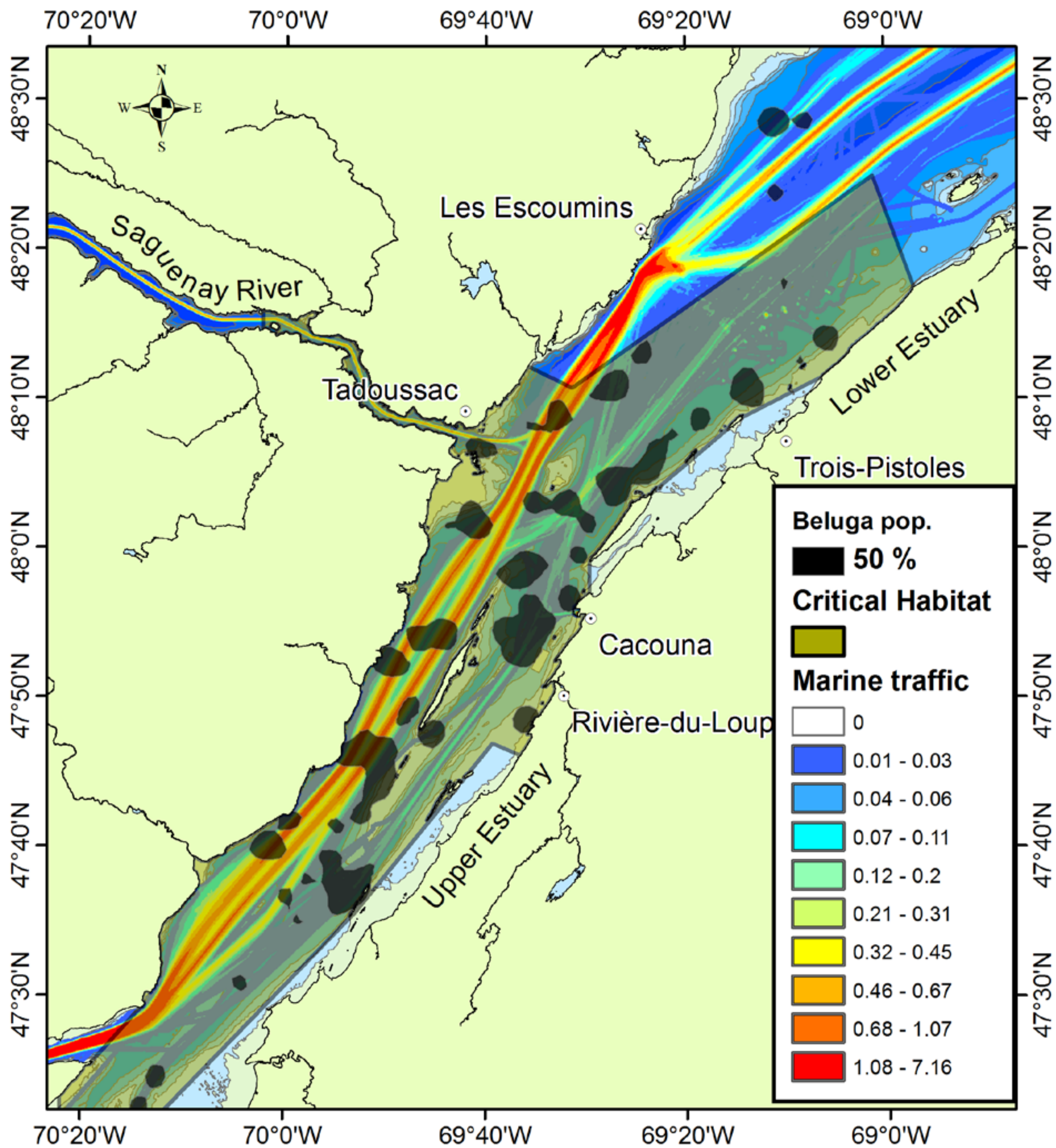

Figure 7. Volume of commercial vessel traffic (estimated as the sum of ship trajectory lengths in metres, over surface unit in squared-metres) in the SLE as indicated by AIS tracking data, and areas where 50% of the SLE Beluga population resides relative to its critical habitat (Figure adapted from Lesage *et al.* 2014b).

Chronic discharge of a variety of chemical and biological contaminants over the past several decades has also contributed to the degradation of SLE habitat quality. Despite regulation or a complete ban on discharge, persistent organic pollutants (POPs), such as polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichloroethane (DDT) are still present in the Beluga environment, and remain stable or are decreasing only at a slow rate in Belugas (Lebeuf *et al.* 2007; Lebeuf *et al.* 2014a). Other toxic chemicals such as polybrominated diphenyl ethers (PBDEs) increased exponentially in Belugas and their environment in the 1990s (De Wit 2002; Lebeuf *et al.* 2004). In addition, new persistent compounds have been recently discovered in the St. Lawrence food chain (e.g., organochlorinated compounds such as tris (4-chlorophenyls)), and are accumulating in Beluga tissues (Lebeuf *et al.* 2001; Lebeuf *et al.* 2007; Lebeuf *et al.* 2014a). Other contaminants of a biological nature such as viruses, bacteria and parasites are also discharged into the St. Lawrence ecosystem from point sources such as municipal sewage, waste water from maritime vessels (cargo ships, recreational boats) and coastal runoff.

Other trends in habitat quality over the past few decades have been linked to Beluga trophic ecology, prey quality and abundance, and environmental conditions in the St. Lawrence (Lesage 2014; Plourde *et al.* 2014), and may have some relevance to the observed changes in Beluga population dynamics over the same time period. The assessment of Beluga diet from 1988 to 2012 has revealed a decline over the period of 2003–2012 of approximately 1 part per mil in a tracer of carbon sources ($^{13}C/^{12}C$ ratio), which corresponds to a drop in nearly one trophic level (Lesage 2014). The food sources and/or environmental factors responsible for this decrease are not known at this time. Changes in carbon isotope ratios can result from either a change in diet or a change in the carbon isotope ratios of preferred prey. For example, in Cook Inlet, Alaska, researchers found shifts of more than one trophic level from one year to the next in some salmonids, albeit based on a very limited sample (Hobbs pers. comm. 2014). A time-series analysis of 28 indices representing ecosystem variability and habitat quality in the Gulf of St. Lawrence identified changes in conditions since 1971, some of which occurred in the period when isotopic tracers in Beluga tissues shifted (Figure 8) (Plourde *et al.* 2014). Some of the changes in the environment also corresponded to when Beluga population dynamics became unstable and when calf productivity and mortality increased, suggesting a decline in habitat quality in recent years (Plourde *et al.* 2014). Specifically, environmental conditions shifted from a period of above to below long-term averages in the late 1990s, with the most extreme conditions occurring between 2010 and 2012. The period of below long-term average environmental conditions was when Gulf of St. Lawrence stocks of large demersal fish (e.g., Atlantic Cod (*Gadus morhua*) and Atlantic Herring (*Clupea harengus*); NAFO Division 4T) had collapsed, and were at their lowest biomass, and when ice conditions were below average and water temperatures above average (Figure 8).

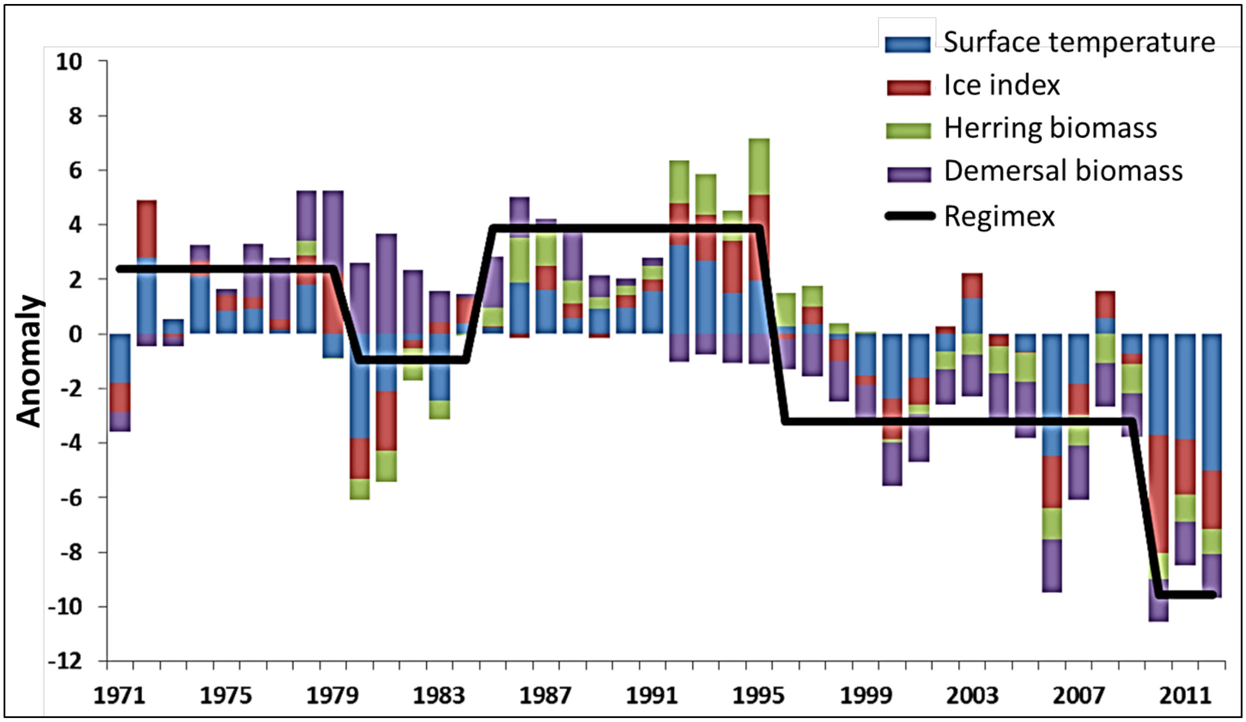

Figure 8. Long-term anomalies in the physical and biological conditions of potential significance for SLE Beluga habitat from 1971 to 2012. Stacked bars represent annual anomalies of physical parameters (surface temperature, ice index) and potential diet sources (4T spring herring, 4T large demersal fish). The black line marks periods of regime shifts. Note that the time series of 4T herring biomass begins in 1978 and that the sign of the temperature anomaly was changed to reflect its potential negative effect on Belugas (Figure from Plourde *et al.* 2014).

The SLE Beluga population also may be affected by recurrent toxic algal bloom events, or red tides, caused by the dinoflagellate *Alexandrium tamarense*. The phycotoxin released by this organism is responsible for outbreaks of paralytic shellfish poisoning and poses serious health risks for marine organisms and humans. In the St. Lawrence, three major red tides have occurred over the past two decades (1996, 1998 and 2008), one of which (2008) was well-documented and coincided with unusually high mortality of a variety of marine organisms, including Belugas, over a short period of time (Truchon *et al.* 2013; Scarratt *et al.* 2014). In the context of climate and oceanographic changes, toxic algal blooms may become more frequent (Anderson *et al.* 2012; Scarratt *et al.* 2014).

Additional factors to consider (e.g., novel or introduced species, species with expanding ranges) are discussed under **THREATS AND LIMITING FACTORS** (below).

BIOLOGY

The following section presents life history parameters assuming 1 ‘growth layer group’ (GLG) in Beluga teeth corresponds to one year of growth (NAMMCO 2012).

Life Cycle, Demographic Parameters and Reproduction

Age of Belugas is determined by reading layers in the dentine (sometimes in the cementum) of the teeth. Double lines, common in Belugas, cause overestimation; wear, loss, or interrupted growth of teeth prevents estimation or produces underestimates (Sergeant 1973). SLE Belugas with 17 GLGs can, and with 20 or more commonly do, have worn teeth; the oldest individual with unworn teeth had 32 GLGs (Lesage *et al.* 2014b).

A longevity for the species has been (probably under-) estimated at 114 GLGs (Harwood *et al.* 2002); for the SLE at 72 GLGs (Lesage *et al.* 2014b). Life expectancy at birth in different populations ranges from 30 to 60 GLGs; in the SLE it is estimated at 34 GLGs (Lesage *et al.* 2014b).

Sexual maturity (evidence of ovarian activity in females, and mature testes in males) occurs at an earlier age in females than males, i.e., 6–14 GLGs in females vs. 16–22 GLGs in males (Brodie 1971; Sergeant 1973; Ognetev 1981; Finley *et al.* 1982; Burns and Seaman 1985; Heide-Jørgensen and Teilmann 1994; Robeck *et al.* 2005; Suydam 2010). In SLE Belugas, the youngest female found dead and carrying a fetus had 7 GLGs (Lair *et al.* 2014), but it is unknown what proportion of females at this age conceive, carry to term or wean a calf. Generation time (see Stewart *et al.* 2006 for calculation), which was estimated at 13–15 years under the 2 GLGs deposition rate assumption (Braham 1984; Burns and Seaman 1985; Lesage and Kingsley 1995), roughly doubles when using 1 GLG per year (Stewart *et al.* 2006) at 26–30 years.

The timing of mating and calving varies between Beluga populations, although in general mating takes place in the spring (Doan and Douglas 1953; Boltunov and Belikov 2002)—between April and June in SLE Belugas (Vladykov 1944). Females give birth to one calf, very rarely two, in July-August following a 14 to 15-month gestation period (Kleinenberg *et al.* 1969; Brodie 1971; Sergeant 1973; Doidge 1990; Heide-Jørgensen and Teilmann 1994). Complete senescence has not been confirmed, but there are indications that fecundity may decline in older females (Burns and Seaman 1985; Lair *et al.* 2014). Lactation may last from 20 months (Brodie 1971; Sergeant 1973; Burns and Seaman 1985; Heide-Jørgensen and Teilmann 1994) to 32 months (Doidge 1990), although ingestion of solid food supplements the diet in the second year of life (Vladykov 1944; Brodie 1971; Sergeant 1973). Lactation may overlap with the following gestation, suggesting a 3-year reproductive cycle (Vladykov 1944; Brodie 1971; Sergeant 1973; Burns and Seaman 1985; Doidge 1990; Heide-Jørgensen and Teilmann 1994). This is supported in SLE Belugas by a long-term study, where peaks in indices of calf production were observed every three to four years (Michaud 2014).

Survivorship in Belugas is generally estimated from age-specific frequencies in harvests (COSEWIC 2004). Due to the absence of a hunt for SLE Belugas, mortality rates, along with other demographic parameters, were estimated from an age-structured hierarchical model fitted using Markov chain Monte Carlo methods within a Bayesian framework. The state process of the model described the true, but unknown, population dynamics of SLE Belugas, including the size of the population and values of demographic parameters at different times, whereas the observational process linked these parameters to data from three input sources: 1) the number and age (newborn vs older Beluga) of individuals reported dead between 1983 and 2012 through a carcass monitoring program, 2) population size estimates from seven photographic surveys flown between 1990 and 2009, and 3) percentage of < 2 years old individuals (i.e., calves and yearlings) observed on aerial photographs from these surveys (Mosnier *et al.* 2014). The dynamics of the population were modelled by considering 11 age-classes grouped into four stages [newborn, yearling, immature (2 to 7 GLGs), mature (8+ GLGs)], each characterized by specific mortality and fecundity rates. Prior distributions describing the range of plausible values of stage-specific mortality and pregnancy rates were derived from the literature (details in Mosnier *et al.* 2014). The model made a number of assumptions based on prior knowledge of Beluga biology, including that if a female caring for a newborn or yearling died during a given year, the latter also died during the same year, and that if a newborn died, the mother became available to reproduce in the following year, i.e., one year earlier than normal.

The model incorporated two periods. The 1913-1982 period used fixed mortality and pregnancy rates and incorporated 1913-1960 hunting catches (Laurin 1982 *in* Reeves and Mitchell 1984). The aim of this part was to minimize sensitivity to the initial age-structure imposed in the starting year of the model (i.e. 1912) by allowing the population to evolve over a period of nearly 70 years. For the period 1983-2012, data from the aerial surveys and the carcass monitoring program were used to inform the model. During this period, mortality and pregnancy rates were random variables that could vary each year, as would be expected in a wild population.

Raw data from the carcass monitoring program indicated year-to-year variation, but no trend in the number of carcasses of mature Belugas reported (male and female) over the period 1983–2012, and unusually high numbers of newborn calf deaths in 2008, 2010 and 2012 with 8, 8 and 16 carcasses respectively, compared to the period 1983-2007 when the number of neonate carcasses varied between 0 and 3 per year (Figure 9) (Lesage *et al.* 2014b). Using carcasses as a sample is not free of bias, as found carcasses may underrepresent deaths in some age classes, such as young juveniles (Béland *et al.* 1988; Lesage *et al.* 2014b; Mosnier *et al.* 2014). Moreover, it cannot be assumed that the numbers of carcasses reflect only mortality rates (a peak of newborn carcasses, for instance, may be the consequence of a peak in birth rates). For this reason, the state process of the population model calculates the number of dead calves by estimating several parameters: the number of females available for reproduction in a given year, their pregnancy rates, birth rates the following year, and both adult and newborn mortality. The resulting number of dead adults and calves is then fitted to the carcass recovery data, while the estimated abundance and proportion of young are fitted simultaneously to aerial survey data. By incorporating all these data, the model estimated mortality rates of approximately 6.1% for adults (8+ GLGs), with interannual variability of 4.0 to 8.7% (Mosnier *et al.* 2014). The 6% annual mortality rate for adult SLE Belugas falls within the 3–8% range of adult mortality rates estimated for five Canadian Arctic Beluga populations (Luque and Ferguson 2010). These Arctic populations are subject to hunting, unlike the SLE population, which has been protected from hunting since 1979. Thus, the adult mortality rate estimated by the model for SLE Belugas appears high, and may imply lower life expectancy than is usually assumed for the species. However, there are no data from the live population to assess life expectancy in SLE Belugas. For newborn calves, mortality rates estimated by the model varied between years, from 8 to 69% (Mosnier *et al.* 2014).

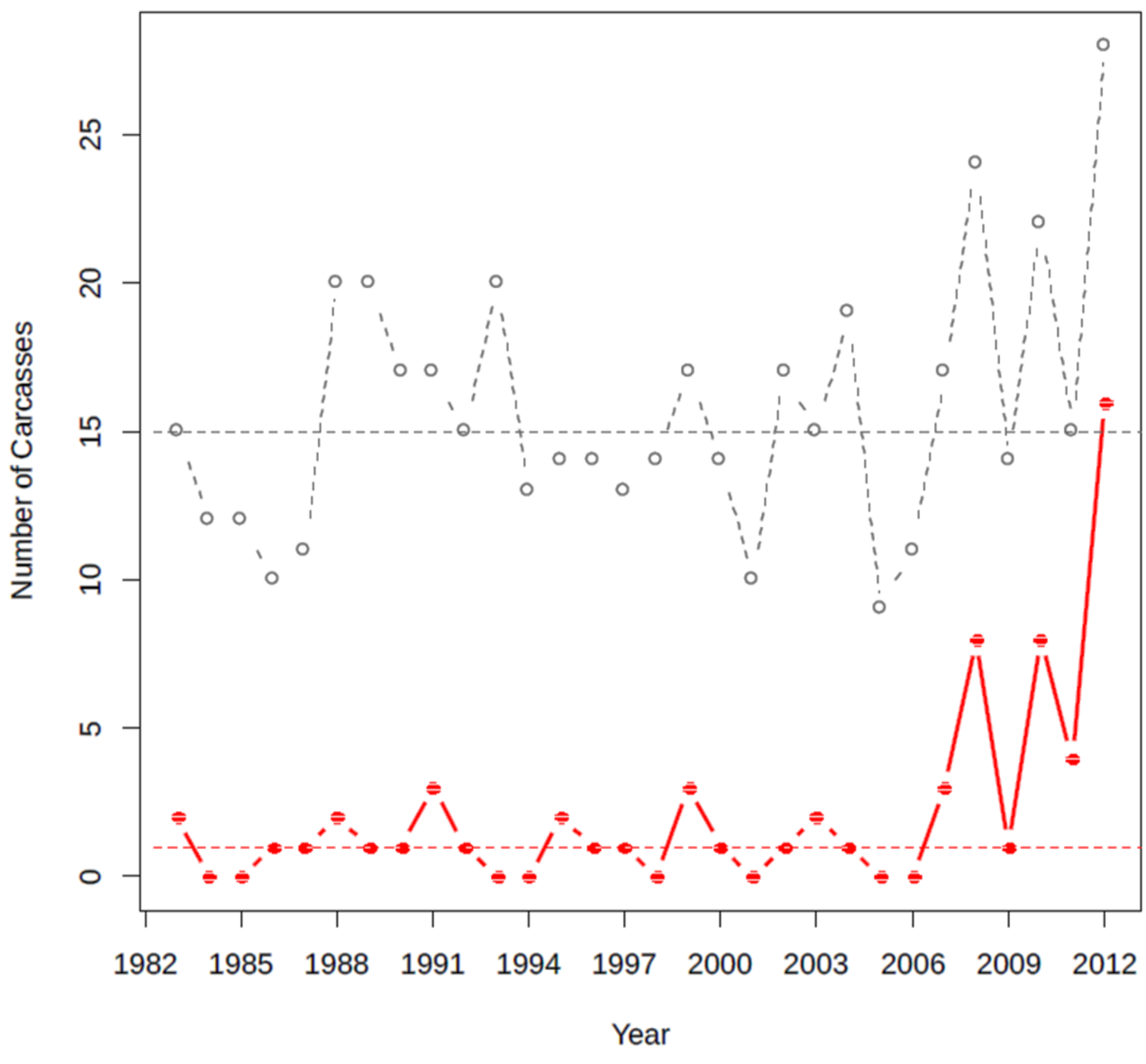

Figure 9. Total (open circles) and neonate (< 1 year old) (closed circles) SLE Beluga deaths reported annually in the Estuary and Gulf of St. Lawrence from 1983 to 2012. The dashed horizontal lines indicate the median of each time series (Lesage *et al.* 2014b).

Reproductive output may have changed in SLE Belugas over the past 15 years. Photogrammetric studies using aerial survey data indicate that the proportion of calves and yearlings in the population fell from 15–18% in the 1990s to 3–8% in the 2000s. These estimates were free of bias from reader differences because all the films were re-examined by the same person (Gosselin *et al.* 2014). The model fitted to the above data, and the other two data sources (carcasses and abundance estimates), revealed a decline of newborns in the population and other major changes in demography since the late 1990s. According to the model, the population appears to have moved from a relatively stable to an unstable period characterized by a shift from a 3-year to a 2-year calving cycle, combined with an increased variability in annual mortality of newborns (8 to 69%), and female pregnancy rates (14.5% to more than 50%), and with a decline in the proportion of immature individuals (Mosnier *et al.* 2014).

Specifically, the model indicated that in the period 1984–1998 the mortality rate of newborns was relatively stable (median values: 14–27% with peaks every 3 to 4 years), as was the pregnancy rate (~30% with small peaks every 3 years). Population age structure was also stable during this period, with a mature:immature ratio of around 59:41, with 7.5% of the population being newborn calves. In contrast, the period from 1999 to 2012 was characterized by demographic instability and major changes in population parameters and age structure: the year 1999 had abnormally high newborn mortality (~40%) and was followed by high pregnancy rates (>50%) in 2000, presumably because more females were available for reproduction after losing their calves in 1999. Since then, there have been spikes in newborn mortality interspersed with spikes in high pregnancy rates, the latter separated by periods of below-average fecundity (~15% in 2001–2002) (Mosnier *et al.* 2014). A pattern also emerged over the last 6 years of the model, with female reproduction apparently shifting from a 3-year cycle, with a third of mature females pregnant each year, to a 2-year cycle, with around half of the females pregnant. This coincided with an increase in newborn mortality. These changes had strong effects on the population age structure. The estimated proportion of newborns in the population deviated from its 3-year cycle and started to fluctuate strongly in the early 2000s, while also decreasing from 6–8% prior to 1999 to 4–6% following 2007. During this same period, the estimated proportion of immatures in the population decreased, resulting in a proportional increase in mature Belugas even though their absolute numbers remained constant (Figure 10).

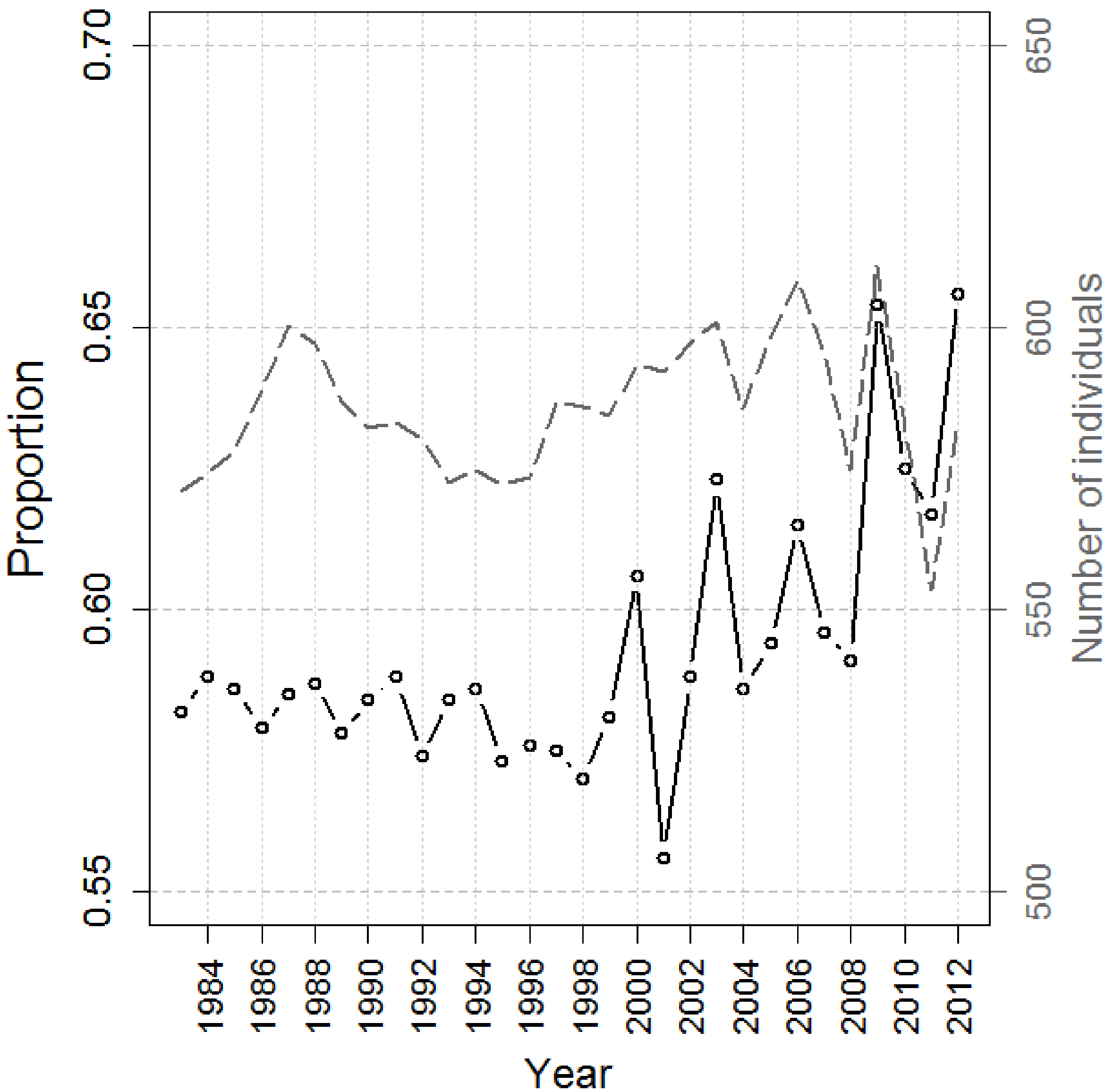

Figure 10. Proportion (solid line and hollow dots) and number (dotted line) of mature individuals (8+ years old) in the SLE Beluga population from 1983 to 2012, as estimated by the age-structured population dynamics model (Figure from Mosnier *et al.* 2014).

The demographic parameters outlined above are based on a model and therefore are sensitive to input data. For instance, the abundance estimates had a large influence on the estimated population trend and the proportion of young seen on the aerial photographic surveys informed the model that the age structure was changing (fewer calves and yearlings being observed), but neither could inform the model on year-to-year variability in demographic parameters. Only the carcass data contained information on yearly variation in the number of dead calves and adults, and therefore these data were the main driver of year-to-year variation in the final model outputs. However, several independent observations increased confidence in model conclusions. A long-term photo-identification program of live SLE Belugas (1989–2012) indicated changes in age structure and calf production that are in agreement with those suggested by the model. In particular, years of high pregnancy rates predicted by the model for the period 2004–2012 were corroborated by observations of high calf production in the field the following year. The photo-identification program also indicated a slight increase in the proportion of grey individuals (juveniles and young adults) from 1989 to the mid-2000s, with a recent transition to a negative trend shown in the model as a reduction in the proportion of immature individuals (Michaud 2014).

Physiology and Adaptability

The Beluga lacks a dorsal fin and has a relatively thick dermis (5-12 mm), which makes the species well adapted to survive in ice-laden waters (Stewart and Stewart 1989). Their hypodermis, a layer of fatty and fibrous connective tissue below the skin, constitutes their main energy reserve and 40% of the body weight (Sergeant and Brodie 1969). The extent of their reliance on blubber fat for withstanding periods of lower food intake is undocumented. However, Belugas appear to feed throughout the year (e.g., Hobbs *et al.* 2008), take two years to wean their calf and thus probably have more in common with income than true capital breeders (Houston *et al.* 2007).

Belugas occupy a variety of polar and temperate habitats which differ considerably in water temperature, salinity, and depth. They can dive to depths of over 800 m (Richard *et al.* 2001) and have been observed in depths as shallow as 4 m in the wild (Martin *et al.* 2001). They can remain submerged for at least 15 min (Martin and Smith 1992; Martin *et al.* 1993; Martin and Smith 1999) and perhaps longer, given that the theoretical aerobic dive limit exceeds this threshold for toothed whales larger than 750 kg such as the Beluga (Schreer and Kovacs 1997). Belugas do not regularly occur at latitudes below 47°N, which suggests they are intolerant of prolonged periods in warm waters. Water temperatures can reach over 12°C in some parts of their range in the SLE during the summer (Plourde *et al.* 2002).

Belugas appear to be highly philopatric to summering sites and estuaries, which may render them vulnerable to a variety of anthropogenic threats. Site fidelity is supported by significant differentiation in mtDNA but not nuclear DNA among Beluga stocks (de March and Postma 2003; Turgeon *et al.* 2012). Site fidelity has also been proposed based on repeated observations of the same individuals over more than a season (Caron and Smith 1990), but was not supported by recent genetic analysis investigating relatedness among

Belugas hunted in the same estuaries, a finding interpreted as a fidelity to general summering areas rather than to specific estuaries (Colbeck *et al.* 2013). Site fidelity might hamper recolonization of abandoned sites, or dispersion to new areas more suitable for Beluga survival (Mosnier *et al.* 2010; Colbeck *et al.* 2013). This was put forward as an explanation hypothesis for the complete or near disappearance of Belugas in some estuaries following extensive hunting (e.g., the Mucalic River in Ungava Bay, Great Whale and Nowliapic rivers in eastern Hudson Bay, and probably the Manicouagan Bank in the SLE (Reeves and Mitchell 1987; Sergeant and Hoek 1988; Hammill *et al.* 2004) although in the case of Manicouagan Bank, it is important to recognize that a series of dams constructed in the Manicouagan and Outardes rivers in the early 1960s caused major hydrological changes that in turn could have made the bank less suitable as Beluga habitat (Sergeant and Brodie 1975). Fidelity (high philopatry) to specific sectors of the estuarine system presumably makes SLE Belugas particularly vulnerable to the impacts of disruptive human activities (e.g., port development and marine hydrocarbon exploration and exploitation) that take place where and when they congregate.

Dispersal and Migration

SLE Belugas appear to undertake only limited seasonal movements (Vladykov 1944; Mosnier *et al.* 2010; Gosselin *et al.* 2014; Michaud 2014). Dispersal is more likely to occur outside the summer period when their distribution extends to the east and into the northwestern Gulf of St. Lawrence (Mosnier *et al.* 2010; Gosselin *et al.* 2014).

During winter, Belugas are found either in the Lower Estuary or the northwestern Gulf of St. Lawrence, which remain partially ice-free throughout winter (Figure 11) (Sears and Williamson 1982; Boivin and INESL 1990; Michaud *et al.* 1990; Lesage *et al.* 2007).

Small numbers of solitary Belugas, likely young individuals, are occasionally reported in nearshore waters of Newfoundland and Labrador in Atlantic Canada. Over the past decade, extralimital reports totalling more than ten have been documented throughout Newfoundland and Labrador (Curren and Lien 1998; Benjamins and Ledwell 2009). Population identity of these lone Belugas is uncertain, although analyses of chemical substances or trace elements suggest an Arctic origin for at least some of the individuals that have been sampled in those areas (Béland *et al.* 1992; Muir *et al.* 1996; Brown Gladden *et al.* 1999b). A group of a few hundred Belugas, containing both adults and juveniles, was sighted and photographed along the west coast of Newfoundland in April 2009 (Lawson pers. comm. 2009). Animals from northern stocks would not be expected to reach such low latitudes based on satellite telemetry data (Bailleul *et al.* 2012). If this sighting involved SLE Belugas, it would indicate that winter movements extend over much larger distances than generally believed.

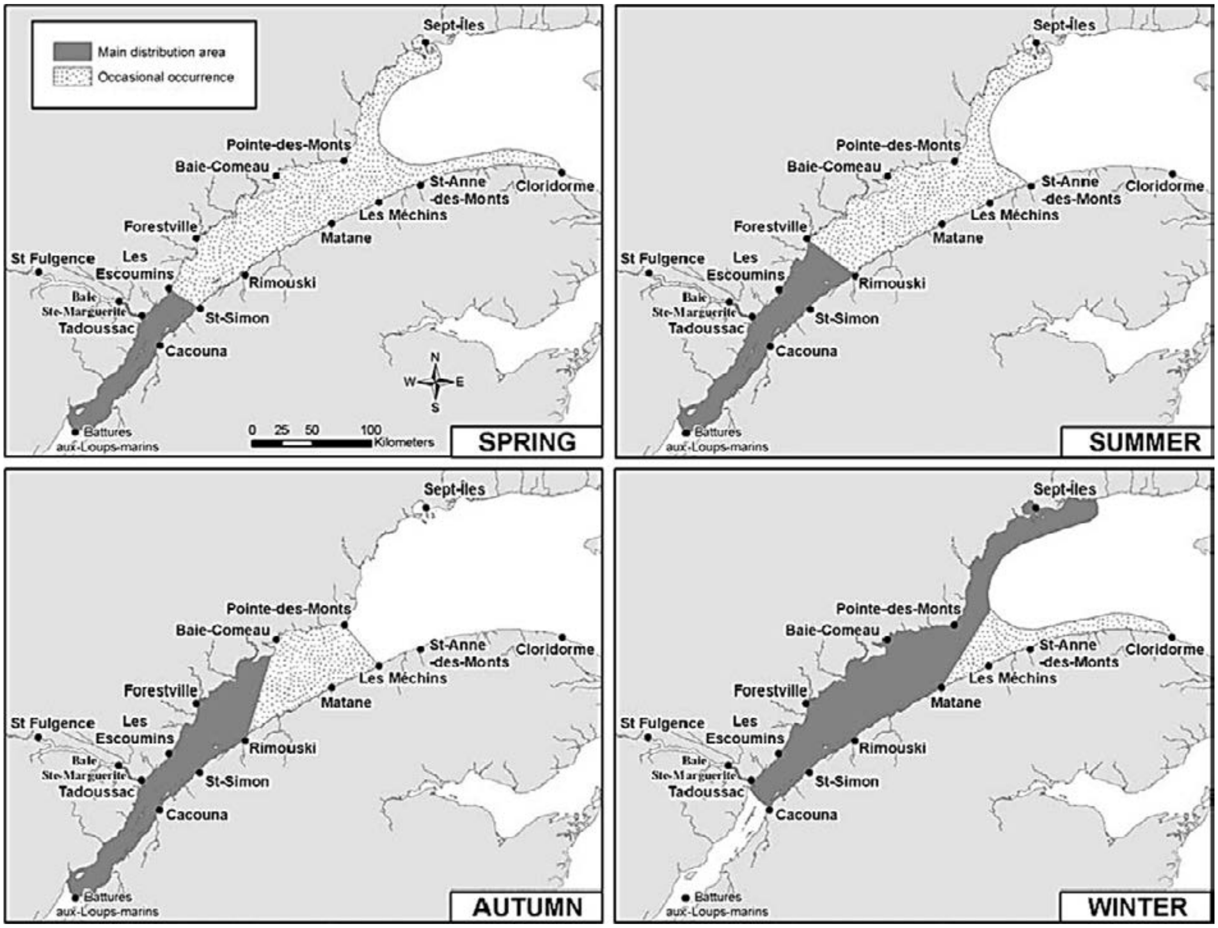

Figure 11. Current seasonal area of occurrence for the SLE Beluga population (Figure from Mosnier *et al.* 2010).

Interspecific Interactions

Predation by Killer Whales (*Orcinus orca*) is at least an occasional cause of Beluga mortality in the Arctic (Mitchell and Reeves 1981; Reeves and Mitchell 1988; Shelden *et al.* 2003; Higdon and Ferguson 2009) and avoidance of mammal-eating Killer Whales has been suggested as one reason for the intensive use of very shallow estuarine waters by Belugas during summer, on the assumption that Killer Whales are unable to navigate such areas as efficiently or safely (Sergeant and Brodie 1969). In the SLE, Killer Whale predation might have played a role in habitat selection by Belugas in the past, when these predators were fairly common there, and some attacks were reported during the early 1900s (Vladykov 1944; Michaud 2005). Killer Whales are now rarely observed in the SLE, and no attacks on Belugas have been reported recently. Greenland Sharks (*Somniosus microcephalus)* are possible Beluga predators (Beck and Mansfield 1969; MacNeil *et al.* 2012); however, there is no evidence of such predation in the SLE.

As for several other marine mammals, Belugas feed at a relatively high trophic level in the estuarine food web of the St. Lawrence ecosystem, and males at a higher trophic level than females (Lesage *et al.* 2001; Lesage 2014). Similar to Belugas elsewhere, SLE Belugas feed on a variety of species, with a diet dominated by fish prey (Vladykov 1946; Lesage 2014). While recent diet data are fragmentary for SLE Belugas (Lesage 2014), a study conducted in the 1930s suggested that pelagic species such as Capelin (*Mallotus villosus*) and herring, sandlance (*Ammodytes* sp.), and large demersal species such as cod (*Gadus morhua* and *G. ogac*) and redfish (*Sebastes* sp.) may be seasonally important in SLE Beluga diet (Vladykov 1946). Several of these stocks have collapsed since the 1990s, and there are currently concerns that Belugas may be competing with fisheries for some of these resources (DFO 2014a; Plourde *et al.* 2014).

The SLE Belugas might also be competing for food resources with other marine mammals, although the extent of this potential interaction remains to be documented. Based on stable isotope ratios, adult female Belugas occupy trophic positions similar to those occupied by Harp Seals, whereas adult male Belugas have a trophic position similar to that of Grey Seals (*Halichoerus grypus*), juvenile Harbour Seals (*Phoca vitulina)* and female Hooded Seals (*Cystophora cristata*) (Lesage *et al.* 2001). Baleen whales occupy slightly lower trophic positions, but with prey items shared with Belugas (Gavrilchuk *et al.* 2014). Several of these marine mammal populations are currently increasing, and it is expected that increased numbers of certain species such as the Harp Seal and the Grey Seal, which enter the SLE mainly to feed, add to the competition pressure for food resources.

Ice cover determines the winter distribution of marine mammal species in the SLE and is predicted to decrease gradually in coming years with climate variability and associated warming temperatures (Bourque and Simonet 2008). Thus, climate change could lead to a lengthening of the ice-free season and may affect SLE Belugas through changes in food resources and increases in interspecific competition as other species expand their range or extend their stay due to loss of ice cover (Kingsley 2002; Measures 2004).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

There was an attempt in the late 1990s to standardize the earlier data and examine long-term population trends (Kingsley 1999). However, the method was criticized and it was argued that only the systematic strip transect photographic aerial surveys conducted since 1988 were comparable and could be used to reliably estimate population trends (Michaud and Béland 2001). A second series of replicate aerial surveys following a line-transect design was initiated in 2003, and is also currently used to examine population size and trends (Gosselin *et al.* 2014) (see Figure 12 for the basic survey design).

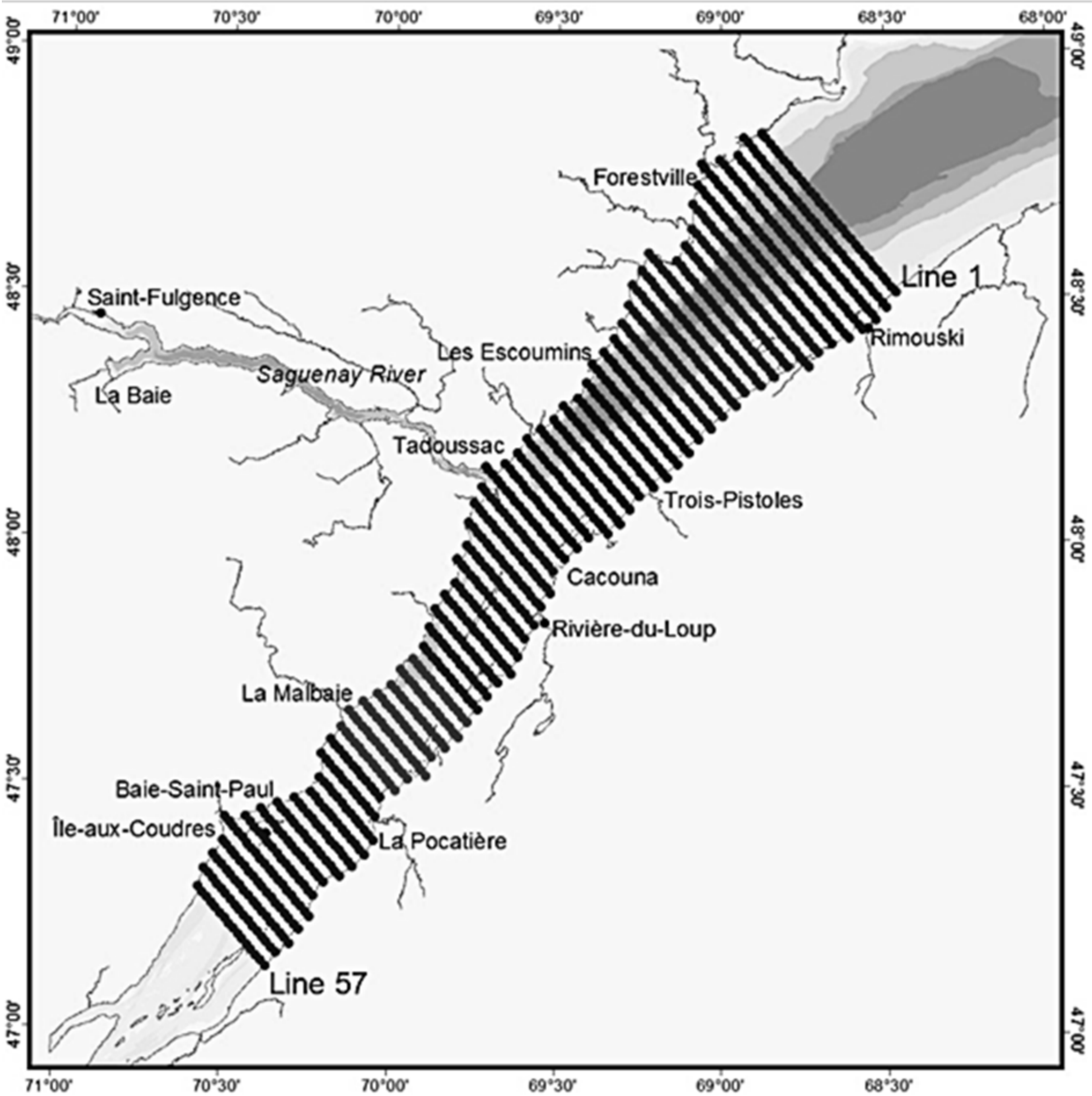

Figure 12. Photographic survey design to estimate abundance of SLE Belugas showing the 57 transects separated by two nautical miles that were flown in August 2009 as an example. Surveys flown since 1988 have followed nearly the same design, with some slight variation in the number of transects. Visual line transects were flown following the same systematic design but with a four-nautical mile spacing (Figure from Gosselin *et al.* 2014).

SLE Belugas occupy a relatively small area during the summer, making the population relatively easy to survey in that season. Each replicate of summer surveys was completed in a single day. Photographic surveys have generally covered around 50% of the total Beluga distribution, whereas slightly lower coverage has been achieved with visual surveys (Gosselin *et al.* 2014). Although survey design was similar between years for the photographic surveys, coverage progressively increased over time to account for a possible expansion of Beluga distribution (Gosselin *et al.* 2014).

Eight photographic aerial surveys were flown between 1988 and 2009, and 28 visual line transect surveys were conducted between 2001 and 2009 (Table 1) (Gosselin *et al.* 2014). In some years, both visual and photographic surveys were flown to assess some of the variability observed between surveys, as well as to compare visual versus photographic abundance estimates. The Saguenay River was surveyed visually by helicopter while photographic/visual surveys were being conducted in the SLE.

Table 1. Beluga abundance in the SLE estimated from photographic aerial surveys (n=8) and visual line transect surveys (n=28) flown between 1988 and 2009. Abundance indices are corrected for animals not visible at the surface (Table from DFO 2014a).

Year	Method	No. of surveys	Estuary estimate	Saguenay count	Corrected abundance index	95% CI
1988	Photo	1	417	22	893	751–1062
1990	Photo	1	527	28	1129	446–2860
1992	Photo	1	454	3	952	702–1291
1995	Photo	1	568	52	1239	881–1742
1997	Photo	1	575	20	1222	903–1654
2000	Photo	1	453	6	953	724–1254
2001	Visual	1	529	15	1122	555–1675
2003	Photo	1	630	2	1319	896–1942
2003	Visual	5	658	7	1378	1039–1828
2005	Visual	14	492	39	1068	891–1280
2007	Visual	1	822	29	1746	1047–2583
2008	Visual	1	502	11	1053	636–1744
2009	Photo	1	319	10	676	499–915
2009	Visual	6	460	17	979	750–1277

Despite standardization of survey methods, there is considerable variability between abundance indices, even within a given year (Gosselin *et al.* 2007). In surveys conducted from 1992 to 2003, 50% of the Belugas detected were on only 10–14 out of approximately 1,000 photo frames. The clumped nature of Beluga distribution and consequent detection or failure to detect large groups can have a substantial effect on the indices.

A correction factor of 2.09 (SE = 0.16) for availability, which was specifically developed for photographic surveys of SLE Belugas (Kingsley and Gauthier 2002), was applied to the density in the SLE, before adding the Saguenay count to provide the abundance indices (Gosselin *et al.* 2014). This correction adjusts for Belugas under the surface and not photographed as the plane passes over. The separation width of aerial survey transect lines and the addition of transect lines over time were accounted for in abundance estimates.

Abundance

The most recent abundance estimates for SLE Belugas were obtained in 2009, using six replicate visual line-transect surveys and one photographic strip transect survey (Table 1). The 2009 estimates were the lowest of the two time series, at 676 individuals (95% CI: 490–906) for the photographic survey, and 979 individuals (95% CI: 750–1277) for the combined visual surveys. The age-structured population model (see section on **Life Cycle, Demographic Parameters and Reproduction**), which incorporates these abundance estimates in addition to other population parameters, estimated a total population of 889 individuals (95% CI: 672–1167) in 2012, of which 583 were mature (8+ GLGs) (Mosnier *et al.* 2014)

Survey estimates for SLE Belugas are associated with relatively wide confidence intervals (15–25% CV) relative to the expected percent change in population size. This uncertainty and that associated with the estimate itself are mainly attributable to the aggregated distribution of Belugas.

Fluctuations and Trends

During the late 1920s/early 1930s, the Québec government subsidized bombing of Belugas in the SLE due to their alleged damage to the cod fishing industry (Reeves and Mitchell 1984). Beginning in 1932, a bounty was offered by Québec for each Beluga killed in the St. Lawrence and a total of 2233 bounties were paid from 1932-1938, with the bounty program ending in 1939 (Vladykov 1944; Reeves and Mitchell 1984). Population size was estimated at 5,000–10,000 individuals in the 1800s and less than 1,000 in the late 1970s when hunting was officially banned (Reeves and Mitchell 1984; Pippard 1985a; Hammill *et al.* 2007; Mosnier *et al.* 2014).

The age-structured hierarchical model described above (under **Life Cycle, Demographic Parameters and Reproduction**), which incorporated historical catch data and recent field survey and carcass report data, suggested that the total population numbered approximately 1017 individuals in 1988, and remained stable or showed a slight increase (growth rate ~0.13% per year) from the end of commercial hunting in the 1960s to the early 2000s (Mosnier *et al.* 2014). The model then predicted a decrease in abundance (-1.13% per year) to 889 individuals (95% CI: 672–1167) in 2012 (Figure 13), equivalent to a 12.6% decline in total population since 1988, or over the last 10 years of modelling, (i.e., between 2002 and 2012), if one assumes a stationary population since 1988. The rate of population decline was affected by the choice of input data, the steepest decline being achieved when fitting only to survey abundance estimates. However, all versions of the model suggested a relatively stable population after hunting ceased, and a decreasing population size since the early 2000s (Mosnier *et al.* 2014). The model specifically indicated that there were 2293 mature individuals in 1934 (3 generations of 26 years = 78 years ago) and 3168 in 1922 (3 generations of 30 years = 90 years ago); assuming 580 mature individuals in 2012 as indicated by the model, the number of mature individuals declined by 75% to 82% over the last 3 generations (78-90 years).

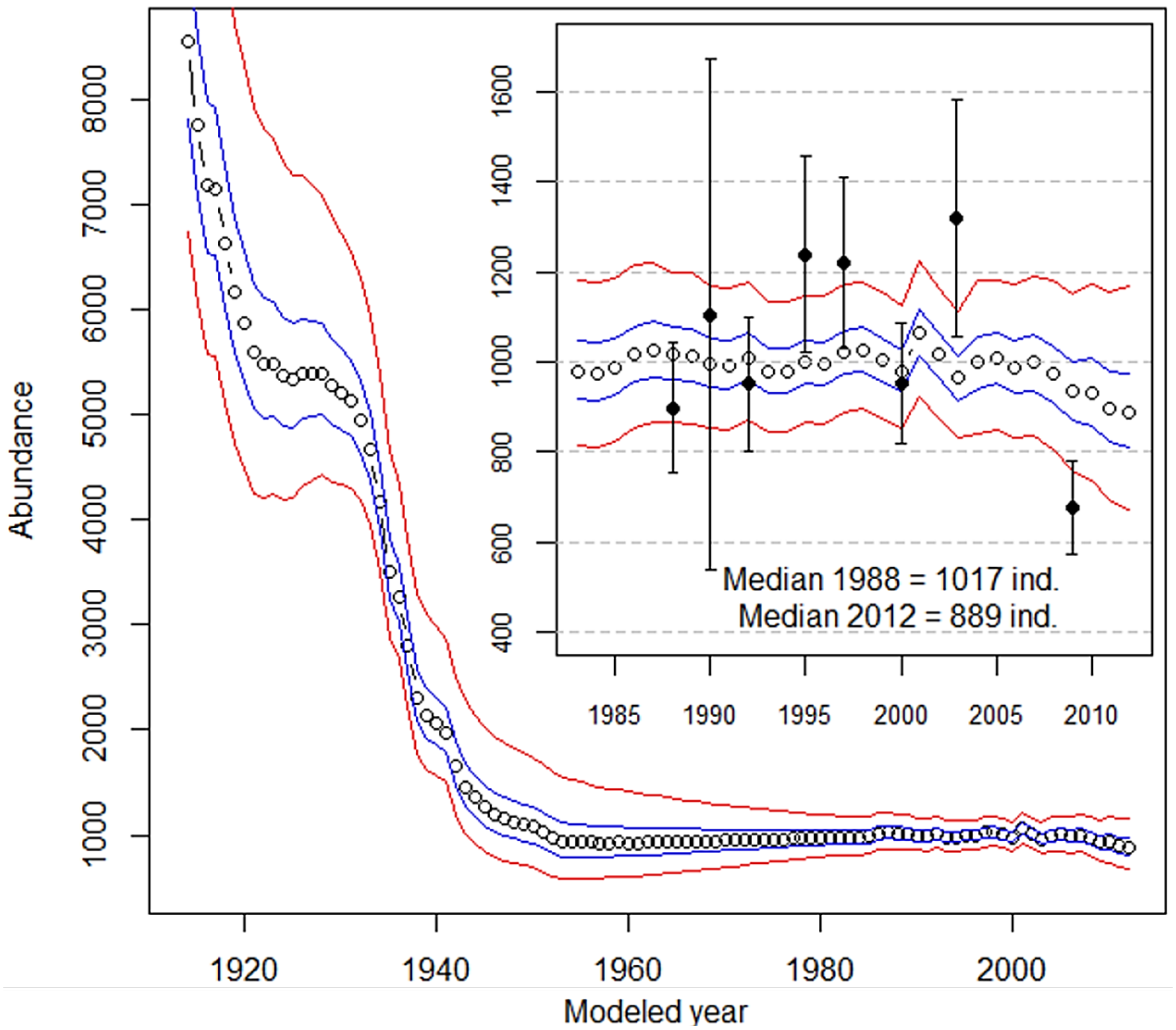

Figure 13. Population trajectory for SLE Belugas from 1912 to 2012 as predicted by the age-structured population dynamics model. Median values (open black circles) are presented with their 50 and 95% confidence intervals (blue and red lines respectively). The inset shows the period 1983–2012 comparing population size (± SE) estimates obtained from the photographic aerial surveys (Gosselin *et al.* 2014) and the model results (Figure from Mosnier *et al.* 2014).

Trends in SLE Beluga abundance and dynamics may be affected by biases in the time series, such as: 1) inconsistencies with photograph frame overlap over the years, which may have led to over- or underestimated counts in certain years; 2) difficulty in detecting all animals on the photographs because grey or dark-colored individuals do not stand out (would negatively bias abundance estimation and calf/juvenile proportions); 3) variability associated with the correction factor applied to account for detectability (animals not seen at the surface) (could cause negative or positive bias); 4) not correcting visual abundance estimates for perception bias (observer error) (would negatively bias abundance estimation from visual surveys but not photographic surveys) (Gosselin *et al.* 2014). It is not possible to make a meaningful assessment of the net effect of these potential biases, but a precautionary interpretation is that SLE Beluga numbers have been declining slowly in recent years and are likely to continue doing so.

Rescue Effect

Immigrating Belugas from Arctic populations presumably would not be adapted to conditions in the St. Lawrence system, although it is impossible to predict whether they would or would not be capable of adapting over time. Cultural knowledge held by individuals in the existing population may be key to its persistence in the SLE habitat, but such knowledge may not be available to immigrants and therefore would not be available at all if the present population were to become extinct.

The likelihood that dispersal from a different population has contributed significantly to, or would repopulate, the SLE Beluga population is considered low (Pippard 1985a; Sergeant and Hoek 1988; Lesage and Kingsley 1998). Significant contributions from other populations would be more likely if they were in closer proximity and not depleted (which most of them are).

Based on what is known concerning migration distances exhibited by other populations of this species (Richard *et al.* 2001; Smith *et al.* 2007; Bailleul *et al.* 2012), Belugas would be capable of moving into and out of the Gulf of St. Lawrence. In some years, small numbers of Belugas have been observed well outside their normal range, with reports from as far south as New Jersey, U.S.A. (Reeves and Katona 1980; Curren and Lien 1998). The proportion of these animals that belong to the SLE population and whether they eventually return to the SLE is largely unknown (Kingsley 2002).

Immigration and a rescue effect would be possible only if suitable habitat was available. The SLE Beluga population currently occupies only a fraction of its historical range (Mosnier *et al.* 2010), has grown at a lower than expected rate since the end of the hunting period, and is currently in decline. Whether the decrease in its occupied range and its limited population growth indicate a reduced carrying capacity, and thus a shortage of suitable habitat for immigrants, is unknown.

THREATS AND LIMITING FACTORS

A threats assessment for this population produced an overall threat impact score ranging from "medium" to "very high". A "medium" overall threat impact indicates an estimated population reduction of 3-30% (median = 15%). A "very high" score indicates an estimated population reduction of 50-100% (median = 75%). Low- to medium-level threats included human intrusions and disturbance from recreational activities. Low- to high-level threats included ecosystem modifications such as those caused by fisheries, invasive and other problematic species, pollution by industrial effluents, air-borne pollutants, excess energy (e.g. anthropogenic noise), and climate change (e.g., severe weather events, and temperature extremes).

Principal causes of death of 222 SLE Belugas that were subjected to complete necropsies since 1983 were infectious disease (32% of the cases), malignant neoplasia (tumours; 14%) and dystocia or post-partum complications in mature females (15%), with additional deaths from vessel strikes (4%), primary starvation (2%), fishing gear entanglement (1%), and intoxication (one case) (Table 2) (Lair *et al.* 2014). Two cases of intersex have been documented in SLE Belugas (one case of true hermaphroditism (De Guise *et al.* 1994) and one pseudohermaphroditic male). These are the only documented cases in cetaceans worldwide (Lair *et al.* 2014). No cases of neoplasia have been documented in SLE Belugas estimated to have been born after 1971 (Lair *et al.* 2014). Immunosuppression increases susceptibility to infectious disease, the leading cause of death in SLE Belugas, and immunosuppression may be associated with social or reproductive stress (Schuurs and Verheul 1989), malnutrition, infectious and non-infectious agents, and chemical contaminants within the system such as PCBs (Hall *et al.* 2006; Lebeuf *et al.* 2007; Selgrade 2007).

Table 2. Primary causes of death in SLE Belugas from 1983 to 2012 ordered by diagnostic category and by age group (Table from Lair *et al.* 2014).

Primary causes of death	Age groups [n (% in age group)]				Total
	Newborn	Juvenile (< 8 GLGs)	Young adult (8 to 19 GLGs)	Mature adult (> 19 GLGs)	
Infectious diseases	-	18 (72%)	8 (36%)	46 (29%)	72 (32%)
Malignant neoplasia	-	-	-	31 (20%)	31 (14%)
Dystocia / post-partum complication	-	-	6 (40%)[1]	12 (15%)[1]	18 (15%)[1]
Neonatal mortality	18 (95%)	-	-	-	18 (8%)
Ship/Boat strike	-	1 (4%)	-	7 (4%)	8 (4%)

Primary causes of death	Age groups [n (% in age group)]				Total
	Newborn	Juvenile (< 8 GLGs)	Young adult (8 to 19 GLGs)	Mature adult (> 19 GLGs)	
Primary starvation	-	-	-	5 (3%)	5 (2%)
Fishing gear entanglement	1 (5%)	-	-	1	2 (1%)
Intoxication	-	-	-	1	1
Other non-infectious causes	-	2 (8%)	3 (14%)	7 (5%)	12 (5%)
Undetermined	-	4 (16%)	5 (23%)	46 (29%)	55 (25%)
Total	19	25	22	156	222

[1] Percentage of females.

Sporadic threats which have the potential to cause multiple deaths in a short time include spills of toxic substances, harmful algal blooms, and epizootic diseases (epidemic in an animal population). Many ships travelling through the St. Lawrence transport petroleum products and other toxic substances, and the number of laden tankers moving through the Seaway began to increase in 2014 with oil from Alberta being offloaded in Sorel from the railway system using existing facilities. Such traffic is expected to increase in the near- and medium-term future.

Human intrusions and disturbance

SLE Belugas are chronically exposed to high volumes of marine traffic including both large and small vessels (Chion *et al.* 2009; Ménard *et al.* 2014; Som 2007). They are considered to be at only low risk of being struck by large commercial ships given the generally slow speed and predictable trajectory of these vessels, and their own manoeuvrability and acute hearing (Johnson *et al.* 1989; Erbe 2008; Mooney *et al.* 2008). However, the whales could be at a relatively high risk of being struck by small or fast-moving vessels or other motorized vehicles, as indicated by a handful of cases documented since 1983 (Lair *et al.* 2014).

Vessel traffic and recreational activities involving motorized or non-motorized vehicles (e.g., kayaks) may interfere with the birth process if direct approaches to calving females are attempted. Vessel traffic related to tourism and recreation peaks in July-August when SLE Belugas give birth, and the volume of this traffic increased in areas used by females, juveniles and calves between 2003 and 2012 (Ménard *et al.* 2014). Disturbance during calving, which may take many hours (e.g., Robeck *et al.* 2005), could be an aggravating factor, especially if the animals are weakened by dystocia, health problems due to contaminants, infections, or other illnesses (Ménard *et al.* 2014). The years 2010 and 2012 were particularly favourable for navigation in the St. Lawrence and they were also years when high numbers of dead calves were reported (Ménard *et al.* 2014). Whether Belugas were exposed to more anthropogenic disturbance in those years than in years with summers of average meteorological conditions is unknown.

Aircraft flying at low latitude may also cause short-term negative behavioural responses (Richardson *et al.* 1995). While flights at altitudes less than 1000 feet (305 m) are prohibited within the limits of the Saguenay-St. Lawrence Marine Park, there is no such regulation in other parts of SLE Beluga habitat.

Natural System Modifications

Fisheries can cause decreased abundance, quality and availability of Beluga prey as well as ecosystem-wide changes. In recent decades, several fish populations in the SLE and the Gulf of St. Lawrence (e.g., American Eel (*Anguilla rostrata*), and Atlantic Cod) have declined significantly, likely as a result of overfishing, but also at least partially due to habitat degradation and barriers to migration (COSEWIC 2006; DFO 2009). The coincidence of changes in the population dynamics of SLE Belugas with the collapse of some overexploited fish stocks supports the hypothesis that there is a relationship between Beluga population growth and the consequences of fishery activities for prey on which these whales depend (e.g., Atlantic Herring) (Plourde *et al.* 2014).

Invasive and Other Problematic Species and Genes

As in many other temperate coastal areas, blooms of the dinoflagellate *Alexandrium tamarense*, a producer of paralytic shellfish toxins which include saxitoxin (STX) and its derivatives, occur on a regular basis in the SLE, and have been associated with mortality of Belugas and other marine species (Scarratt *et al.* 2014). The strain of *A. tamarense* native to the SLE is noted for being extremely noxious, and there are indications of chronic sub-lethal exposure in SLE Belugas in recent years, which may render the animals more vulnerable to other stressors and accidents (Scarratt *et al.* 2014). Eutrophication, climatic variability, and changes in rainfall patterns may lead to higher frequency and severity of toxic algal blooms caused by *A. tamarense* and other toxic algae species occurring in the SLE (Van Dolah 2000; Anderson *et al.* 2012). The risk may be particularly acute in small, isolated populations such as the SLE Beluga, which could be significantly affected by a single intoxication event (Scarratt *et al.* 2014).

Epizootic diseases are caused primarily by viruses such as papillomavirus and herpesvirus, which have been reported in SLE Belugas (De Guise *et al.* 1994; Lair *et al.* 2014). Other pathogens such as the *Brucella* bacterium and the protozoan *Toxoplasma gondii* can cause infectious diseases leading to reproductive disorders (Mikaelian *et al.* 2000; Nielsen *et al.* 2001). Cetacean distemper virus or cetacean morbillivirus (CeMV) poses a high risk to SLE Belugas because they apparently have not been exposed previously (Mikaelian *et al.* 1999; Nielsen *et al.* 2000). CeMV has caused hundreds of deaths of cetaceans elsewhere in the world (Taubenberger *et al.* 1996) and a related virus, phocine distemper virus (PDV), has caused thousands of deaths of pinnipeds (Osterhaus and Vedder 1988; Jensen *et al.* 2002), including recently in New England (Earle *et al.* 2011). From 2013 to 2014 more than 1,200 cetaceans reportedly died from an epizootic of CeMV off the east coast of the U.S.A. (NOAA 2014). Morbilliviruses cause broncho-pneumonia, encephalitis, immune suppression and death and can quickly become epizootic due to their highly contagious nature and ease of transmission among social animals (Kennedy 1998; Di Guardo *et al.* 2005). Belugas are at risk of becoming infected with morbilliviruses through contact with terrestrial or marine mammal carriers (Barrett 1999; Philippa *et al.* 2004).

Several factors render SLE Belugas vulnerable to epizootics: small population size, gregariousness, limited distribution, isolation from neighbouring populations, a potentially weakened immune system from chronic exposure to contaminants, and low MHC haplotype diversity, which is essential in antigen-specific immune responses (Murray *et al.* 1999; Nielsen *et al.* 2000; DFO 2012). A global warming trend could favour pathogen survival and transmission, or expansion of the range of exotic infected marine mammal species into the SLE and Gulf of St. Lawrence, which would expose SLE Belugas to exotic pathogens to which they may have no immune resistance (DFO 2002; Measures 2004, 2008; Burek *et al.* 2008). Biological contaminants from municipal sewage, waste and ballast water from maritime vessels, and coastal runoff discharged into the St. Lawrence ecosystem may also infect SLE Belugas causing morbidity and death. These may include coliform bacteria, human enteric viruses, protozoan parasites such as *Cryptosporidium* and *Toxoplasma gondii*, as well as antibiotic-resistant bacteria (Measures and Olson 1999; Higgins 2000; Mikaelian *et al.* 2000; Payment *et al.* 2000, 2001; Miller *et al.* 2002; Measures 2004).

Microorganisms such as viruses, bacteria, parasites and toxic algae may affect the longevity or reproductive success of Belugas. Infectious diseases were the cause of death in 32% of Belugas examined by necropsy between 1983 and 2012, and diseases were particularly prevalent in young Belugas (Lair *et al.* 2014). These included bacterial infections (11%), verminous pneumonia (11%), verminous gastro-enteritis/peritonitis (4%), toxoplasmosis (2%), protozoal pneumonia (2%) and herpesviral infections (1%). Only one case of saxitoxin intoxication, caused by the dinoflagellate *Alexandrium tamarense*, was documented in 2008, although this organism was suspected to have been responsible for several additional deaths during the massive bloom event documented that year in the SLE (Scarratt *et al.* 2014; Starr unpubl. data). Non-fatal infections by different species of parasitic worms were documented in some Beluga carcasses (Lair *et al.* 2014). Such infections are believed to weaken the immune system or decrease the fitness of heavily infected individuals.

Pollution

The strong tides and currents, seasonal ice cover, and frequent fog characteristics of the SLE and Gulf of St. Lawrence increase the risk of toxic spills. So far, there have been very few major spills in the St. Lawrence, and most have occurred in ports (Villeneuve and Quilliam 1999). Nevertheless, a major toxic spill can have widespread effects as pollutants spread rapidly (Kingston 2005). Because the area occupied by SLE Belugas is limited, and considering the proposed petroleum port within their critical habitat, a large oil spill could affect a significant number of individuals and have long-term consequences in a large proportion of their range (Peterson *et al.* 2003). International statistics on small (< 7 tonnes), medium (between 7 and 700 tonnes), and large spills (> 700 tonnes) from oil tankers indicated a consistent decline both in the spill volume and number of incidents over the period 1970 to 2013. Small and medium-sized spills accounted for 95% of the incidents recorded worldwide during this period, with 40% of small spills and 29% of medium-sized spills occurring during loading and discharging operations, which normally take place in ports and oil terminals (ITOPF 2013). A recent study examining current oil spill risk in Canadian waters, based on the most recent 10 years of vessel traffic and oil volumes combined with current environmental information, identified the St. Lawrence River and Gulf of St. Lawrence as being among the zones with the highest probability of a large spill occurring (WSP Canada Inc. 2014). In Canada, 30 water pollution incidents involving spills of oil, chemicals or other pollutants were reported between 2007 and 2009 at oil handling facilities (i.e., average of 10 per year). Volumes of spills were not available (Office of Auditor General of Canada 2010).

SLE Belugas live downstream of the Great Lakes and the St. Lawrence River, a densely populated and highly industrialized region of Canada and the United States. Consequently, the SLE Belugas are among the most contaminated marine mammals (DFO 2012). Chemical and biological contaminants in the St. Lawrence ecosystem come from a variety of sources (agricultural, industrial and municipal waste, maritime shipping, dredging operations, and others) and are of concern for the recovery of the SLE Beluga population. Although actions have been taken to ban or reduce toxic chemical discharges (e.g., the International Joint Commission of Canada and the United States' Great Lakes Water Quality Agreement of 1978), some contaminants will persist in the ecosystem and Beluga tissues for decades (Lebeuf *et al.* 2007, 2014a). Persistent organic pollutants are transferred, some with high efficiency, from one generation to another (Desforges *et al.* 2012; Lebeuf *et al.* 2014a). New contaminants such as toxic flame retardants (polybrominated diphenyl ethers or PBDEs), accumulated at an exponential rate in Belugas until their regulation in the late 1990s, but are still at their maxima in adult and newborn Beluga tissues (De Wit 2002; Lebeuf *et al.* 2004, 2014a, 2014b). Others continue to appear in the environment, as those recently reported in American Eel from eastern Canada, a potential prey of SLE Belugas (Byer *et al.* 2014). Some pathologies associated with chronic exposure to chemical contaminants may take many years to develop (15–25 years), suggesting that past pollution may still compromise the health of the current population. In addition, effluents from municipal sewage treatment plants contain residues of detergents, pharmaceutical products, and various other contaminants with hormone-disrupting chemicals. The effect of these contaminants on Belugas is unknown, although they have the potential to accumulate in the food chain (see references in DFO 2012).

Chemical contamination may be contributing to the abnormally high rates of cancer and other diseases observed in SLE Belugas (Lair 2007; Lair *et al.* 2014), as well as to changes in the reproductive system, although a cause and effect relationship has not been established, and may never be, in SLE Belugas (Béland *et al.* 1992; De Guise *et al.* 1996; Martineau *et al.* 2003; Lebeuf *et al.* 2010, 2014b; Lair *et al.* 2014). For a summary of the main types of chemical contaminants present in the St. Lawrence ecosystem, see Appendix 2 of the Beluga Recovery Strategy (DFO 2012). The hypothesis proposed to explain the high level of cancer in SLE Belugas is exposure to carcinogenic chemicals such as polyaromatic hydrocarbons (PAHs) (Martineau *et al.* 1994; De Guise *et al.* 1995; Martineau *et al.* 1995, 1998, 2002). The occurrence of gastro-intestinal adenocarcinomas in SLE Belugas (extremely rare in cetaceans) suggests a relationship between cancer and PAHs. It was speculated that Belugas may ingest carcinogenic sediment (Martel *et al.* 1986) during suction feeding on benthic prey (Pelletier *et al.* 2009), which could lead to development of cancers of the digestive tract (Martineau *et al.* 1995). However, this hypothesis has been the subject of debate (Dillberger 1995; Theriault *et al.* 2002; Hammill *et al.* 2003). The absence of cases of neoplasia in Belugas born after 1971, i.e., after direct discharges of PAHs from aluminum smelters ceased, tends to support the hypothesis of a relationship between intestinal adenocarcinoma and PAHs (Lair *et al.* 2014). Other pathologies suspected of being caused by chemical contamination have since been associated with advanced age (Measures 2008; Lair *et al.* 2014).

While SLE Belugas appear more tolerant of vessel traffic (Blane and Jackson 1994; Lesage *et al.* 1999) than Belugas in the Arctic, where shipping is (or was until recently) nearly non-existent (Finley 1990), they are not immune to disturbance. Physiological and vocal responses to noise have been documented in SLE Belugas (Lesage *et al.* 1999; Scheifele *et al.* 2005), and their abandonment of sectors such as Tadoussac Bay following the construction of a marina is suspected to be related to increased vessel traffic (Pippard 1985a). There is growing recognition that exposure to ship noise and other chronic, low-intensity noise might affect cetaceans and other aquatic organisms, and be of great significance in affecting individual fitness and population status (Wright 2009; Tyack 2008; Hatch and Fristrup 2009; Clark *et al.* 2009). Noise can mask important signals, reduce "acoustic space," divert attention and disrupt natural behaviour, lead to habituation or 'learned deafness', and cause chronic stress (Rolland *et al.* 2012; Hatch and Fristrup 2009; Clark *et al.* 2009). Noise exposure may compromise physiological functions by reducing the energy and time allocated to critical activities (e.g., foraging) or by impairing social interactions (e.g., acoustic connections as calves venture away from their mother for longer periods during weaning (Smolker *et al.* 1993; Taber and Thomas 1982; Tyack and Clark 2000). At the Saguenay River mouth, the potential communication space for Belugas is reduced by vessel traffic to less than 30% of its expected level under natural noise conditions for half of the time, and to less than 15% for one quarter of the time, regardless of call frequency (McQuinn *et al.* 2011, Gervaise *et al.* 2012). Depending on source levels and transit directions, merchant ships travelling through the SLE expose up to 15-48% of the Beluga population to noise levels in excess of 120 dB re 1 µPa RMS approximately 18 times per day (Lesage *et al.* 2014b). Such levels may make the environment unsuitable for Belugas to carry out vital functions (DFO 2012).

Climate Change and Severe Weather

Climate models are forecasting that the Gulf of St. Lawrence will be ice-free within 50 years (Dufour and Ouellet 2007). The Beluga is an ice-adapted species and its capacity to survive in an environment where ice may be reduced or absent, and mean water temperatures increased, is unknown. Increased water temperature and reduced ice-cover may affect Belugas directly by reducing shelter from storms during winter (Barber *et al.* 2001), or could alter ecosystem structure, affect food availability and increase interspecific competition as other species expand their ranges due to a loss of ice cover (Moore and Huntington 2008; Heide-Jørgensen *et al.* 2010). Many fish species are sensitive to water temperature, which affects survival, spawning, growth and migration period and routes (Gilbert and Couillard 1995; Minns *et al.* 1995; Narayana *et al.* 1995; Gilbert 1996; Gilbert and Pettigrew 1996). In addition, biodiversity and productivity in the SLE and Gulf of St. Lawrence is burdened by hypoxia, or oxygen deprivation (Diaz 2001), conditions that might further affect prey availability to SLE Belugas.

Commercial Development, Transportation and Service Corridors

Industrial activities related to coastal development may reduce habitat quality for SLE Belugas. Construction and operation of a proposed petroleum terminal at Cacouna, in one of the few areas where females, juveniles and calves congregate and where they have been only lightly exposed to ship noise (DFO 2014b), would likely reduce the quality and quantity of critical habitat, and therefore must be seen as a potential threat to SLE Beluga recovery.

Blane and Jackson (1994) observed that Belugas showed ship avoidance behaviour by prolonging the intervals between surface breathing, increasing swimming speed, and forming tighter groups. As mentioned earlier, Belugas may have abandoned the Bay of Tadoussac and altered their movements at the mouth of the Saguenay River as a result of increased marine traffic in that area (Pippard, 1985a; Caron and Sergeant, 1988). The St. Lawrence Estuary is used by an increasing variety of vessels, and the threat of ship strikes to belugas is correspondingly increasing. Dredging (for maintenance, Rivière-du-Loup) outside shipping lanes and port maintenance operations which occur on a regular basis in various parts of the critical habitat, even though in a restricted area, temporarily affect the habitat of a small proportion of the population. The impact of such disturbance is unknown.

Other Factors

The Beluga has a relatively long life expectancy, late sexual maturity, and low reproductive rate (Ray 1981), all factors that could limit recovery. In the event of mass mortality, the SLE Beluga population would take many years to return to its current population size (DFO 2012). Further, in small isolated Beluga populations such as that in the SLE, the likelihood of inbreeding and inbreeding depression is relatively high. Inbreeding depression and lowered heterozygosity can reduce metabolic efficiency, growth rate, and reproductive rate, as well as affect immune system function and disease resistance (Gilpin and Soule 1986; O'Brien and Evermann 1988; Knapp *et al.* 1996; Keller and Waller 2002). The SLE Belugas have low genetic diversity (de March *et al.* 2002), but the degree to which this might affect their reproduction or general health is uncertain.

Number of Locations

The threats assessment revealed one location in which a single threatening event could rapidly affect all individuals of the taxon present.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Hunting of Belugas in the SLE was prohibited in 1979 by the Beluga Protection Regulations under the *Fisheries Act*, which was replaced by the Marine Mammal Regulations in 1993. The currently applicable regulations are being revised, but it is likely to remain unlawful to disturb a marine mammal except with exemptions under permit.

In 1983 COSEWIC designated the SLE Beluga population as Endangered (Pippard 1985a), and this designation was reaffirmed in 1996 (Lesage and Kingsley 1998). The population's status was changed to Threatened in 2004 (COSEWIC 2004). SLE Belugas have been listed as Threatened under the Québec Act respecting threatened or vulnerable species (CQLR, c E-12.01) or '*Loi sur les espèces menacées et vulnérables*' (RLRQ, c E-12.01) since March 2000. Most recently, COSEWIC assessed the status of the SLE Beluga Whale population as Endangered in 2014.

The SLE Beluga population was listed as Threatened on Schedule 1 of the Canadian *Species at Risk Act* (SARA) in May 2005. The Act prohibits the killing, harming, harassment, capture, or take of any individual of this species (DU), or damage to the residence of one or more individuals. The Act also prohibits the destruction of any part of the critical habitat of the species, and requires that a Recovery Strategy be prepared and critical habitat be identified. An initial Recovery Strategy for SLE Belugas was developed prior to their listing under SARA (DFO and WWF 1998). A second Recovery Strategy, including formal identification of critical habitat, was published in 2012 (DFO 2012). Critical habitat of SLE Belugas corresponds to the area occupied in summer by females accompanied by calves and juveniles (Figure 6).

An Action Plan to implement the Recovery Strategy for SLE Belugas is expected to be available by 2016 (DFO 2012). In 2012, recovery of the SLE Beluga population was deemed feasible, with the long-term goal of achieving a population of 7,070 individuals, or 70% of its estimated historical size. At a population growth rate of 4%, this level of abundance would have been achievable by the 2050s. However, at a rate of 1% (Hammill *et al.* 2007), which was the assumed growth rate for the population at the time the Recovery Strategy was written, this goal would not be reached for another 90 years. Thus, an intermediate objective of 1,000 mature individuals was proposed (DFO 2012). It is unlikely that original recovery targets and time frames for reaching them will be met.

Belugas are also protected under the Marine Activities in the Saguenay-St. Lawrence Marine Park Regulations (2002) adopted under of the *Saguenay-St. Lawrence Marine Park Act*. The Saguenay-St. Lawrence Marine Park, one of Canada's first marine protected areas, was established to favour the recovery of the Beluga population in 1998. The park is managed by Parks Canada, and permits are required to operate a marine tour business or shuttle service, to conduct scientific research or to hold a special activity in the park. These regulations prohibit the killing, injury or disturbance of any marine mammal, and require that a minimum distance of 400 m be maintained between a vessel and a species or population that is listed as endangered or threatened under SARA, which includes SLE Belugas.

The Beluga is also protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES monitors international trade in products derived from protected flora and fauna to ensure the survival of these species. In Canada, CITES is administered and enforced under the *Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act*. The SLE Beluga population is listed in Schedule II under CITES, which stipulates that a permit is required to import or export Beluga samples.

Non-Legal Status and Ranks

The Beluga is red-listed as Near-Threatened by the IUCN. NatureServe has assigned it a global status of G4T3Q[1] (last reviewed in 24 Oct 2000), which indicates that the species is 'apparently secure'. The 'T-rank' following the species' global rank specifies that SLE Belugas qualify for an 'Infraspecific Taxon Conservation Status Rank' of 3, or vulnerable: "At moderate risk of extinction or elimination due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors." The qualifier 'Q' used after the T-rank denotes the informal nature of the population intraspecific taxonomic status. Nationally, SLE Belugas have a status of N2 (15 Nov 2011) and thus are considered "Imperilled - at high risk of extirpation." (NatureServe 2014). At the provincial level, V. Lesage, DFO, has provided the rank assessment for the SLE Beluga population as S1: "Critically imperiled - at very high risk of extirpation in the jurisdiction." The proposed change in status from S2 to S1 was accepted by the Québec government, and will be updated on the NatureServe website in the spring of 2015 (Gauthier pers. comm. 2014).

[1] This status is expected to be changed to G4T1Q to follow the recent change in S-rank from S2 to S1 (Gauthier pers. comm. 2014).

According to Wild Species, the most current (2010) general status for the Beluga is Secure at the Canada level, and At Risk in the Atlantic, where the SLE population is the only one of this species (Wild Species 2010).

Habitat Protection and Ownership

Until recently, the Canadian *Fisheries Act* prohibited any activity that could alter, disrupt, or destroy fish habitat, which, as defined by the Act, included marine mammal habitat. The *Fisheries Act* was amended in 2012 to afford protection to the habitat of fish against serious harm. However, this protection extends only to fish that are *part of or supporting a commercial, recreational or Aboriginal (CRA) fishery* (DFO 2013). SLE Belugas are not fished (or hunted), and do not support a CRA fishery; consequently, their habitat is no longer legally and directly protected under the amended Act. However, because SLE Belugas coexist with fish species that are considered to be part of or that support a CRA fishery, some features of the Belugas' habitat may be afforded protection indirectly by the *Fisheries Act* prohibition against serious harm to fish habitat.

The *Fisheries Act* also regulates the introduction of toxic substances into fish habitat. Further federal regulatory or legislative measures exist to control activities liable to affect the SLE Beluga population and its habitat, such as the *Canada Shipping Act* (2001), the *Canadian Environmental Assessment Act* (1992), and the *Canadian Environmental Protection Act* (1999) (DFO 2012).

A significant piece of legislation for habitat protection is SARA, which requires that the critical habitat of all listed species be legally protected within six months once identified in a finalized SARA Recovery Strategy or Action Plan. However, legal protection of the SLE Beluga critical habitat, which was, according to SARA requirements, due in September 2012, was still pending as of September 2014.

At the provincial level, the SLE Belugas and their habitat are protected directly or indirectly under various other laws and policies: the *Loi sur les espèces menacées ou vulnérables* (RLRQ, c E-12.01) (LEMV) (Act respecting threatened or vulnerable species) (CQLR, c E-12.01), the *Loi sur la qualité de l'environnement (RLRQ, c. Q-2) (Environment Quality Act) (CQLR, c. Q-2),* and the *Loi affirmant le caractère collectif des ressources en eau et visant à renforcer leur protection (chapitre C 6.2)* (Act to affirm the collective nature of water resources and provide for increased water resource protection) (chapter C-6.2). SLE Belugas and their habitat are also afforded protection under the *Loi sur la conservation* et *la mise en valeur de la faune* (RLRQ, c. C- 61.1) (LCMVF) (*Act* respecting the conservation and development of wildlife) (CQLR, c. C-61.1). Under article 26 of the LCMVF, it is illegal to disturb, destroy, or damage the eggs or nest of an animal. It is also prohibited to capture, hunt, and/or keep in captivity any species / animals that are native to Québec.

In 1998, the Saguenay-St. Lawrence Marine Park (SSLMP) covering 1,245 km² was established in the SLE as a measure to protect the Beluga population, as well as provide refuge for other transient marine mammal species including rorquals. One of the protections for habitat that are listed in the *Saguenay-St. Lawrence Marine Park Act* is the prohibition of seismic surveys and oil and gas development within the limits of the Park.

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Katy Gavrilchuk is a biologist under contract to the Marine Mammal Research group of Fisheries and Oceans Canada. She recently completed her Master's research at Université Laval in Québec on trophic niche partitioning of four species of rorquals in the Gulf of St. Lawrence following the collapse of groundfish stocks. She has worked as a field biologist for the Mingan Island Cetacean Study, a non-profit organization in Québec, since 2007.

Véronique Lesage has worked for Fisheries and Oceans Canada, Maurice Lamontagne Institute, Québec, for 14 years as scientist in charge of Cetacean Ecology Research, with a special focus on species at risk. She has been studying Belugas and other marine mammals over the past 25 years. Dr. Lesage has been a member of the Board of Scientific Advisors for the Society for Marine Mammalogy from 2008 to 2014 and a member of Arcticnet and Québec Ocean. She holds adjunct professor status at Université Laval and Université du Québec à Rimouski (UQAR). Much of her research involves population, ecology and behaviour studies of Belugas and baleen whales. Her past and current research on St. Lawrence Belugas has focused on examining effects of anthropogenic noise on Beluga communication, exposure to noise in their preferred habitat, trophic ecology, habitat use, and population dynamics. She is the lead author of three reviews on the status and biology of SLE Belugas, including one prepared for COSEWIC in 1998, as well as the most recent one conducted by DFO in 2013. She has published over 30 papers in the primary scientific literature on many aspects of arctic and temperate-region seal and whale research, and nearly 50 reports and advisory documents for DFO, of which half dealt specifically with Belugas in the Arctic or the St. Lawrence Estuary.