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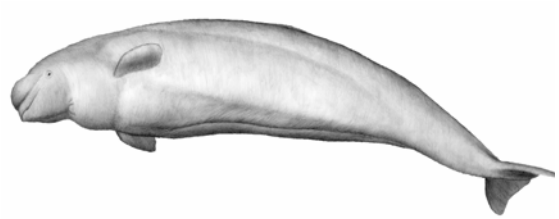
RECOVERY POTENTIAL ASSESSMENT OF CUMBERLAND SOUND, UNGAVA BAY, EASTERN HUDSON BAY AND ST. LAWRENCE BELUGA POPULATIONS (*Delphinapterus leucas*)



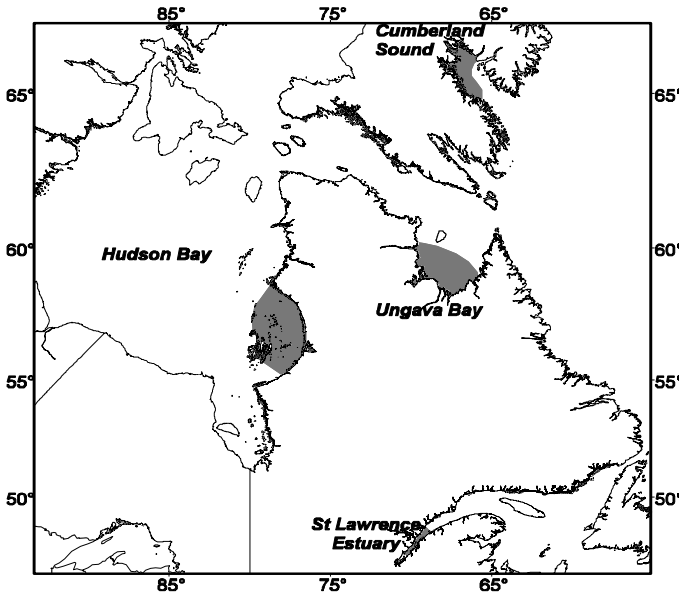


Figure 1. Summer distribution of Cumberland Sound, eastern Hudson Bay, Ungava Bay and St. Lawrence beluga populations.

Context

Beluga whales occur throughout the Canadian Arctic and in the St. Lawrence River estuary. Seven populations are recognized, of which the Cumberland Sound, Eastern Hudson Bay (EHB), Ungava Bay and St. Lawrence River Estuary (SLE) beluga populations are considered endangered or threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The Southeast Baffin Island-Cumberland Sound population was designated Endangered in April 1990. In May 2004, the structure of the population was redefined and named "Cumberland Sound population", and the Southeast Baffin Island animals were included as part of the Western Hudson Bay population. The status of the Cumberland Sound population was re-examined and designated as threatened in May 2004. The reason for designation is that numbers declined by about 1500 animals between the 1920s and the present. This decline is due to harvesting by the Hudson Bay Company until the 1940s and harvesting by the Inuit until 1979. Hunting has been regulated since 1979 and current quotas appear to be sustainable. Potential threats identified in COSEWIC Assessment Status Report include the increase of small vessel traffic, and the associated noise of outboard motors, as well as the fishery removals of Greenland halibut, a food of belugas.

Eastern Hudson Bay (EHB) beluga were designated as threatened in 1988, and as endangered in 2004. The population was reduced by at least 50% by commercial harvesting and continued to decline until recently. High subsistence harvest levels have prevented recovery. In COSEWIC Assessment Status Report, concerns have been expressed about habitat degradation of estuaries by hydroelectric projects

and by small traffic disturbance.

Ungava Bay beluga were designated as endangered in 1988 and this status was confirmed in 2004. Hunting was considered as the cause of the decline, and as a threat to any remaining animals from this population. All signs indicate that the population residing in Ungava Bay is very low and may be extirpated. However, extirpation is difficult to confirm, because small numbers are still seen at the Mucalic River and animals from other populations may visit Ungava Bay.

St. Lawrence Estuary (SLE) belugas were designated as endangered in 1983 and in 1997, and changed to threatened in 2004. The population was severely reduced by hunting which continued until 1979. Systematic aerial surveys conducted since 1988 indicate that the decline has ceased, but do not provide clear evidence of a significant increase in numbers. Potential threats identified in the past included the levels of contaminants that remain high in beluga tissues, and vessel traffic and industrialization of the St. Lawrence watershed that might pose a threat to the whales and their habitat.

SUMMARY

Cumberland Sound Beluga

- In Cumberland Sound, reconstruction of the historical population using the available catch information provides an estimated historical (pre-commercial whaling) population size of 8,465 (S.E. = 426). A Bayesian model estimated the 2002 population size to number 2,018 (95% C.L.: 1,553-2,623), or 24% of its estimated historical population size. The population is estimated to be on an increasing trend even with the quota-regulated local subsistence hunt.

- A recovery target at 70% of historical population size would correspond to 5,926 individuals. This target could be reached in 40, 55 and 90 years for harvest scenarios of 0, 20 and 41 (actual quota), respectively. The population would likely decline under a harvest scenario of 60.

- Subsistence hunting might be considered as a threat to the Cumberland Sound beluga population. Nevertheless, the actual carefully managed subsistence hunt, that inflicts a low mortality rate, does not seem to be an impediment to recovery over the long term.

Eastern Hudson Bay Beluga

- Estimates of the historical (pre-commercial whaling) Eastern Hudson Bay (EHB) beluga population size using catch data and a population model suggest a minimum population of 12,500 belugas in 1854. Modelling of current population size indicates that the population has declined from 4,200 (SE=300) whales in 1985 to 3,100 (SE=800) in 2004, and would be at 25% of its historical size. The population would likely stabilize at current harvest levels (60 belugas).

- A recovery target at 70% of the historical estimate would represent 8,750 belugas based on current information. This target could be reached by 2046 with a complete closure of

harvesting, by 2081 with a reduction in reported harvests to 25 animals, and by more than 150 years from now with a reported harvest of 40 animals.

- Subsistence hunting continues to be a cause for concern. There is uncertainty associated with total numbers of animals actually harvested by Inuit from Nunavut (Sanikiluaq), Nunavik and along the Labrador coast, as well as the stock identity of the animals taken by these hunters.

Ungava Bay Beluga

- In Ungava Bay, reconstruction of the historical population using the available catch information provides an estimated historical (pre-commercial whaling) population size of 1,900 animals in the late 1800s. There are no current estimates of abundance for this population, but modeling suggests that numbers are less than 200 animals. Small numbers of beluga continue to be seen in the Mucalic River, in southern Ungava Bay during the summer. This population may be extirpated and the few beluga observed in Ungava Bay may be from neighboring stocks.

- A recovered population of 70% of the historical estimate would number 1,330 animals. There is no scope for human induced mortality with this population. Any harvesting on this population poses a threat to recovery.

St. Lawrence Beluga

- Historical (pre-commercial whaling) abundance of beluga in the St. Lawrence River Estuary was likely in the order of 10,100 animals during the 1800s. High harvests led to a decline in the population. Although protected from harvesting since 1979, little sign of recovery has been observed. Fitting a population model to aerial survey data collected between 1988 and 2003 suggests that the population has increased only slightly from 900 (SE=70) animals in 1988 to 1100 (SE=200) animals in 2003.

- Since there is currently no harvesting of this population, it is unclear whether the failure of this population to increase more rapidly results from high mortality rates, a reduction in recruitment or a combination of the two. If the factors limiting growth of this population could be identified and rectified, then the population would be expected to reach the recovery population level of 7,070 by 2049. If current conditions continue, then recovery would not be expected before 2101.

DESCRIPTION OF THE ISSUE

Context for Interpreting Recovery under the Species at Risk Act (SARA)

The guidance on interpreting "recovery" in SARA, and as derived from the meaning of conserving biological diversity, taken from the Convention on Biological Diversity (1992), to which Canada is a signatory, clearly indicates that the intent of recovery should not be a population just marginally greater than criteria which would indicate that the population is at risk of extinction. Rather the recovered population should be of a size that the ecosystem in which it occurs would have its normal structure and functions and the population would sustain human uses. These concepts are all consistent with an interpretation of the objectives of a recovery plan being a healthy population, and not one which is marginally not at risk of extinction.

Following that reasoning, and given the fact that no framework was available to determine minimum recovery targets (strictly based on biological and ecological grounds) and reasonable timeframes for recovery, the first part of the meeting included discussions on those aspects of recovery under SARA requirements. Those discussions permitted the development of interim descriptions of the biological properties of suitable recovery targets and recovery times that could be applied to the beluga populations until a formal framework is available. The following paragraphs only gives the key aspects from those discussions that were used to conduct the recovery potential assessment for each beluga population (see CSAS Proceeding Series 2005/011 for details).

Characteristics of a Recovered Beluga Population

The recovered state for a population might be a combination of many characteristics (fulfill historic role in the ecosystem, occupies some percent of historic range, subpopulation structure restored, etc.). Among them, a population that has reached some percent of its historic population size was considered a key criterion. For beluga populations, 70% of the historic (pre-commercial whaling) population size is considered to be consistent with patterns of natural variability for many species with life histories characteristics of cetaceans. This recovery target was used for the following assessments. It corresponds to the characteristics that the beluga populations were estimated, or thought to have had, when they were healthy. Well before those targets are reached the populations will be in conditions when they would no longer be at risk of extinction.

Recovery Times

The management measures necessary to achieve any recovery target (whether for a "healthy" population or some other) depend strongly on the time it will take to achieve the target. Unless a population is thought to be at imminent risk of extinction due to "small population" factors or severe threat, a biological basis for choosing one recovery time over another is hard to establish. However, the longer it takes for a population to recover, the longer it stays at risk, and the greater is the potential that some catastrophic event or change in conditions could jeopardize survival or recovery of the population.

Another consideration in selecting a recovery time as well as a recovery target is the ability to report with confidence that progress is being made towards recovery. Provision 46 of SARA requires that "the competent Minister must report on the implementation of the recovery strategy, and the progress towards meeting its objectives, within five years after it is included in the public registry and in every subsequent five-year period, until its objectives have been achieved or the species' recovery is no longer feasible. The report must be included in the public registry". This, combined with the requirement (Section 24) that COSEWIC reassess each listed species at least every 10 years, give strong guidance that DFO is expected to be able to report on success or lack of success in achieving population recovery. This is a statistical issue, which depends on the precision of estimates of the population size as well as the rate of population growth.

The approach adopted at the meeting was to look at various options which assumed different levels of precision (CVs) in estimating population size and different potential growth rates of the populations. These options tables can inform decisions both about the value of investing in science to improve accountability on recovery, and on the consequences of giving human uses priority over population increases, when allocating surplus production from the population. The greater is the investment in population recovery and in monitoring, the sooner it will be possible to document that the population is actually recovering.

The results indicate that, if a beluga population was growing at 4% (maximum plausible population growth rate for beluga) and the CV of surveys was small (15%), we could detect beluga population growth with a power of 60% after 8 years of annual surveys with a statistical error probability (alpha) of 10% and after 10 years for an error of 5%. The number of years required increases (up to 21 for alpha =10% and 26 for alpha= 5%) if surveys are less frequent (3 year ≥ interval ≥ 5 year) and the survey CVs are large (35%). A growth rate of 2% would allow modest human-induced mortality but the number of years required to detect growth in the population increases.

Science can provide information on the level of survey effort needed to detect population growth under different harvest scenarios. However, it is a policy and strategic decision regarding the level of investment in science that can be done, and hence the minimum CV (and detection time) that can be expected. It is also a policy and strategic decision regarding the acceptable rate of recovery. Thus, the rest of this report will put emphasis on the recovery potential assessment of each beluga population of concern, i.e. their actual status compared to what is considered as their recovered state, and the time expected to reach this recovered state under various subsistence harvest scenarios.

Species Biology

Beluga whales have a circumpolar distribution. They are a medium-sized toothed whale with an average adult length of 280-370 cm and weigh an average of 360-810 kg, depending on the sex and population. Mating is thought to occur in March-April, with calving occurring mostly in mid-summer. The calves are born after a 14 month gestation and lactation lasts for roughly 18 months. The calving interval is one calf every 3 years. At birth, the calves have been described by different authors as being brown or dark bluish in colour. As they mature, the skin becomes lighter in colour gradually turning to grey and then to white. Female beluga are sexually mature between 4 and 7 years of age assuming two

growth layer groups (GLGs) in teeth per year. In the EHB population, 57% of the light grey animals may be sexually mature. Beluga have a lifespan of about 30 years, but maximum lifespan is difficult to determine owing to wearing of the teeth.

Beluga lack a dorsal fin, which is believed to be an adaptation to inhabiting ice covered waters. They are often associated with estuaries, which has led to the view that they are a shallow water species. However, aerial surveys and satellite telemetry indicate substantial movements offshore and diving to depths of over 600 m.

Belugas are generally separated into different populations based on the summer distribution of animals. Preliminary assessments show that Cumberland Sound belugas are different in their genetic composition when compared to all other Canadian stocks. Satellite-tracking also suggests that they remain in Cumberland sound year-round. Beluga that summer in Ungava Bay, along the eastern Hudson Bay coast, and the western Hudson Bay coast have been recognized as separate populations. Genetic analyses have supported the hypothesis that eastern and western Hudson Bay beluga belong to two separate stocks, while samples have yet to be obtained and analysed from beluga that summer in Ungava Bay and James Bay. Genetic analyses also indicate that St. Lawrence beluga form a separate population.

RECOVERY POTENTIAL ASSESSMENT

Cumberland Sound Beluga

In Cumberland Sound, beluga numbers were estimated to be in the low hundreds in the early 1980s, which lead to establishing a quota system to regulate harvests. Three aerial surveys flown in 1990 resulted in counts, not corrected for submerged animals of 454 to 497 belugas. Two surveys flown in 1999, resulted in counts of 720-777 animals. Correcting the 1999 estimate for submerged animals results in a total of 1,960 (SE=250) belugas in Cumberland Sound.

Bayesian estimation of parameters of a Pella-Tomlinson model of the Cumberland Sound beluga population dynamics resulted in a historical estimate of population size of 8,465 (SE=426) and an estimated 2002 population size of 2018 (SE=271). A complete closure of the harvest or a reduction in reported harvest levels to 20 would allow recovery (70% of historical population estimate) to be achieved in 2045 and 2060, respectively (Figure 2) while maintaining the harvest at the current quota of 41 would allow this target to be reached in 2095. The population would likely decline under a catch scenario of 60.

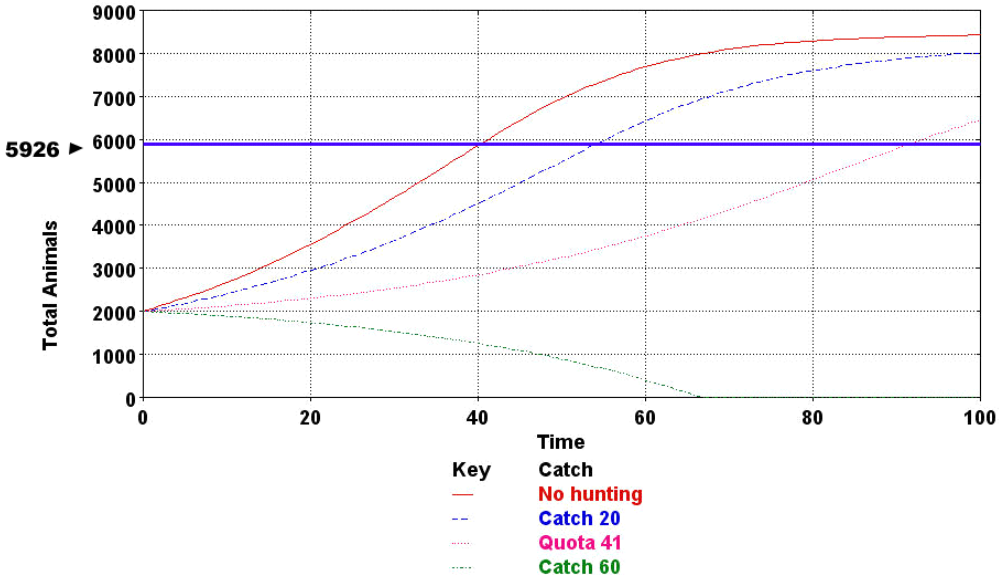


Figure 2: Time for Cumberland Sound beluga to recover to a population size of 5,926 (recovery target) under different reported harvest scenarios of 0, 20, 41 and 60 whales.

Subsistence hunt, if not managed properly, is considered as a demonstrated threat to the Cumberland Sound beluga population. Nevertheless, a subsistence hunt carefully managed can allow the population to reach its recovery goal (70% of historical population size) over the long term. Killer whale predation, contaminants, disease, ice and tidal entrapment, net entanglement and bycatch are also demonstrated threats although the immediacy and severity of each is still not fully understood. Other anthropogenic and environmental concerns have been identified as possible (speculative) threats to this population: climate change, competition for prey (e.g. turbot fishery), anthropogenic noise and disturbance, pollution and loss of habitat. Current conditions for recovery are considered as good but a lower harvest would allow a more rapid recovery.

Eastern Hudson Bay Beluga

In EHB, estimates not corrected for diving animals, of 2,294 (SE=728, assuming CV=17%), 1,314 (SE=489), 1,418 (SE=635) and 2,045 (SE=698) beluga, were obtained from aerial surveys flown in 1985, 1993, 2001 and 2004 respectively. The apparent increase in survey estimates between 2001 and 2004 are too large to be accounted for solely by population growth. Belugas tend to have a clumped distribution. At low population numbers, detection or failure to detect groups of whales has a significant impact on the final abundance estimates. Survey conditions in 2004 also differed from the 2001 survey. Persistent ice may have altered the distribution of whales in the James Bay and southern Hudson Bay area. Extensive fog resulted in the survey taking about one week longer to complete than normal, which could have resulted in the movement of significant numbers of animals between areas. This also resulted in observer changes, which had an unknown impact on whale detection. The survey was also flown at a lower altitude with the expectation of improving whale detection, but owing to poor weather, calibration tests to compare whale detection at 457.2 m (1985, 1993 and 2001 survey altitude) with whale detection at 304.8 m (2004 survey) could not be completed.

A Pella-Tomlinson model incorporating density dependence, an estimated historical population size of 12,500 animals, variability in rates of increase, reported harvests, and variability in harvest composition was used to fit changes in population size to the EHB aerial survey estimates that had been corrected for submerged animals by multiplying the survey estimates by 2.09. The population model indicates that beluga in eastern Hudson Bay have likely declined from an estimated population of 4,200 (SE=300) animals in 1985 to 3,100 (SE=800) in 2004 (Figure 3). At current harvest levels the population is likely stable. A complete closure of the harvest or a reduction in reported harvest levels to 20, 30 or 35 animals would allow recovery to a population of 8,750 (70% of historical population estimate) in 2046, 2069, 2103 or after 2155 respectively (Figure 4).

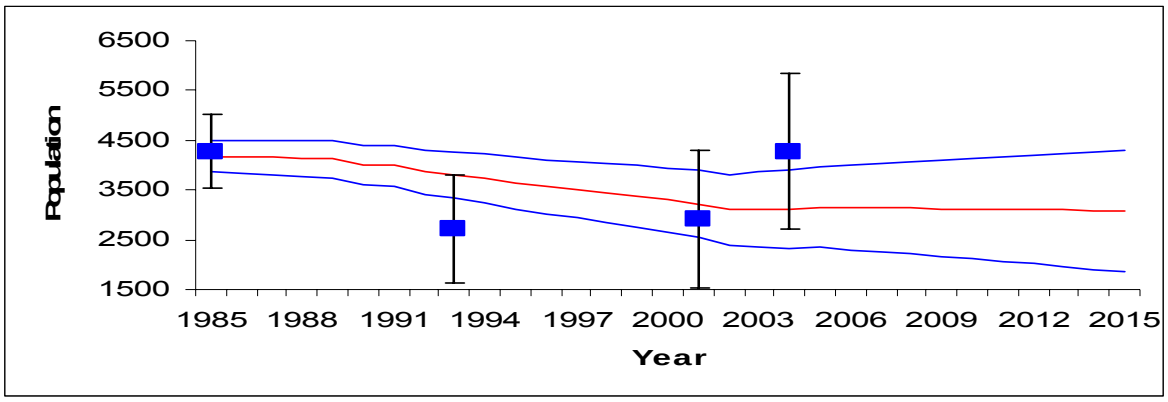


Figure 3. Aerial survey estimates (Mean ±SE) and predicted trajectory of Eastern Hudson Bay beluga if current reported harvests of about 60 EHB whales continue. The blue lines represent the 95% confidence limit.

High subsistence hunt is considered as an imminent and demonstrated threat to the Eastern Hudson Bay beluga population. Nevertheless, it may be regulated via a management plan for directed catches and a monitoring of the EHB beluga harvest as by-catch in the harvest of neighboring beluga stocks. Based on the information available, Killer whale predation is not considered a threat to this population. Contaminants, disease, ice and tidal entrapment, net entanglement and bycatch are demonstrated threats although the immediacy and severity of each are currently not thought to cause significant mortality in this population. Other anthropogenic and environmental concerns have been identified as possible (speculative) threats to this population: climate change, competition for prey (e.g. turbot fishery), anthropogenic noise and disturbance, pollution and loss of habitat.

EHB animals summer near the Belcher Islands (Nunavut) and overwinter along the Labrador coast. Current data indicate that harvest of EHB animals near the Belcher Islands is very low. Changes in overall harvest size and/or changes in the timing of harvesting in this area could have a negative impact on EHB beluga. Along the Labrador coast, current beluga harvests are very low. Cause for concern could arise if there are significant increases in beluga harvest levels in this area.

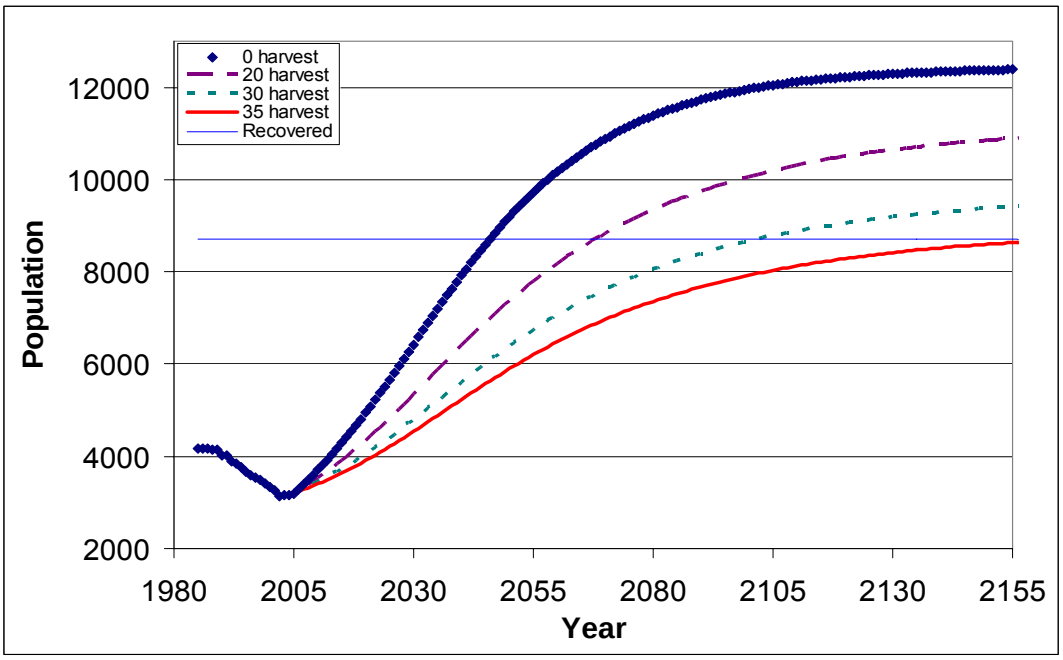


Figure 4. Time for EHB beluga to recover to a population size of 8,750 under different reported harvest scenarios of 0, 20, 30 and 35 whales.

Ungava Bay Beluga

In Ungava Bay, systematic surveys were flown in 1982, 1985, twice in 1993, and 2001. Surveys flown between 1985 and 2001 flew along the same lines. No whales have been observed on transect. Consequently, this area was not surveyed in 2004. With the current survey design, a minimum population of 200 whales at the surface would be required to have a moderate probability of detecting animals on transect. Using information on catches from the commercial harvest conducted by the Hudson Bay Company and modelling different values for the rate of population increase and the number of animals struck but not recovered or reported, the Ungava Bay population numbered at least 1,914 whales in the late 1800s. Current population numbers are too low to evaluate properly. Although this population may have been extirpated, continued sightings and occasional harvesting at the Mucalic River in southern Ungava Bay suggests either that the population persists or that the area is frequented by whales from neighbour stocks. Given the low numbers of animals, there is no scope for human induced mortality with this population. Any harvesting on this population poses a threat to recovery. Any intrusive activity should also be avoided at the current depleted level of this population.

Killer whale predation, contaminants, disease, ice and tidal entrapment, net entanglement and bycatch are demonstrated threats to beluga in general although the immediacy and severity of each is still not fully understood nor quantified for this population. Other anthropogenic and environmental concerns have been identified as possible (speculative) threats to this population: climate change, competition for prey (e.g. turbot fishery), anthropogenic noise and disturbance, pollution and loss of habitat.

St. Lawrence Beluga Population

In the St. Lawrence River estuary, seven estimates of abundance are available from aerial surveys completed between 1988 and 2003. Survey estimates, not corrected for diving animals, range from a low of 432 (SE=144) animals in 1988 to a maximum of 631 (SE=263) in 2003. A Pella-Tomlinson model incorporating density dependence, an estimated historical population size of 10,100 animals, and variability in rates of increase, was used to fit changes in population size to aerial survey estimates that had been corrected for submerged animals. This correction was determined by multiplying the survey estimates by 2.09. Fitting the population model to the adjusted aerial survey data indicates that the population has not declined (Figure 5). In fact the population appears to have shown little change since the current series of systematic aerial surveys was initiated in 1988. Belugas in the St. Lawrence River estuary have been protected from harvesting since 1979, but have shown little change in population size. The reasons for this are not known; it could result from higher than normal mortality rates or from lower than expected levels of recruitment. At a current growth rate of approximately 1% per year, recovery to a population of 7,070 (70% of historical population estimate) might be achieved in 2100. If factors limiting recovery can be identified and rectified, so growth is closed to the maximum of 4 %, then recovery could be expected by 2049 (Figure 6).

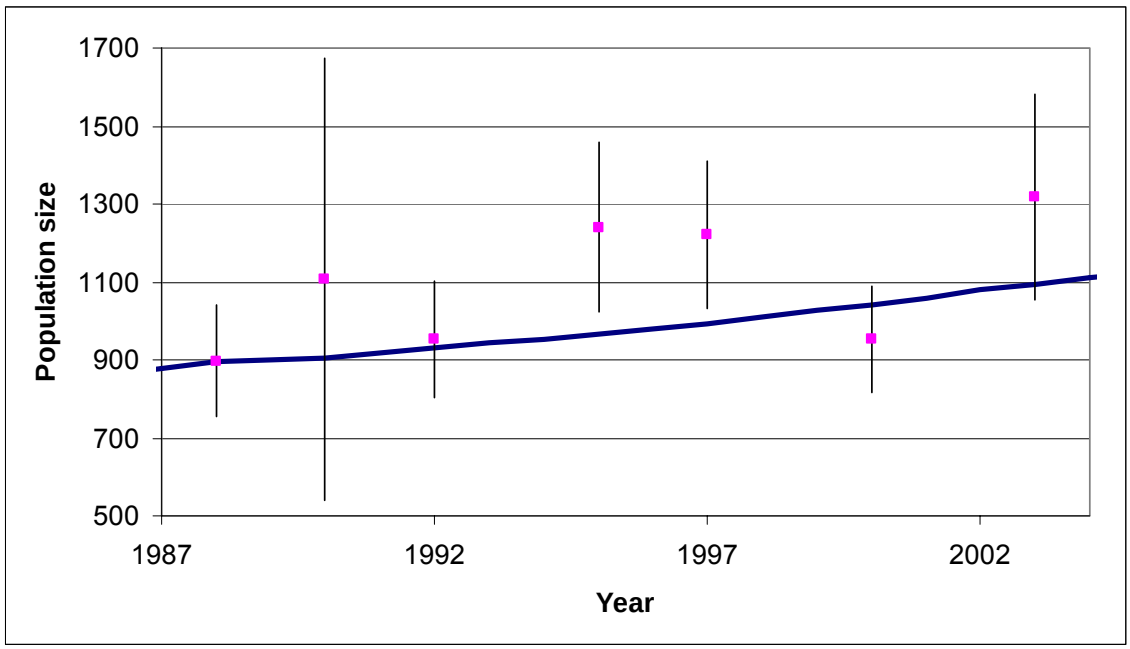


Figure 5. Aerial survey estimates (Mean ±SE) and population size predicted by model fitted to the aerial survey data.

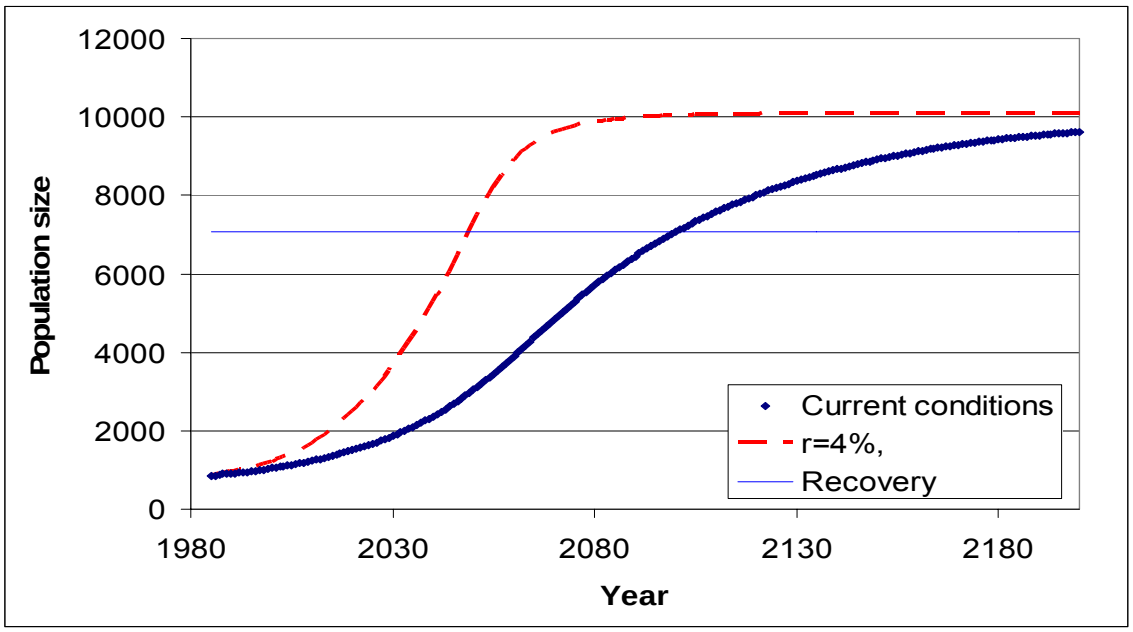


Figure 6. Time for St. Lawrence beluga to recover to a population size of 7,070, if current conditions continue and if factors limiting population growth could be identified and corrected. r is the maximum rate of increase.

No imminent sources of threat have been identified. Threats known to kill beluga but not observed for this population in recent decades are bycatch in fishing gear, contaminants, diseases, stranding events, and tagging activities. Other sources of threats, considered as speculative and hypothetical have also been identified: competition for prey with commercial fisheries (e.g. turbot), pollution (municipal waste, oil, ballast water), noise disturbance, loss of habitat, hydroelectric development, whale watching activities, killer whales, oil spill, climate change and catastrophic epizootic outbreak.

This population has been protected from harvesting since 1979. In spite of this protection, the population is stable or recovering very slowly. Under these conditions an annual growth rate of 4% per year would be expected. The low growth rate may result from low productivity, unusually high mortality rates or a combination of the two. A better knowledge of the causes of this low growth rate followed by appropriate management measures would allow better conditions for recovery of this population.

Sources of uncertainty

Available data on exploitation and abundance of these stocks are neither unbiased nor sufficiently comprehensive to yield precise estimates. Owing to the combination of the small size, mobility and non-uniform distribution of animals and in the case of the northern Quebec beluga stocks, the large area that must be flown, the estimates are very sensitive to the detection or failure to detect animals during the surveys. This may not be the case for Cumberland Sound belugas who are predictably more aggregated in Clearwater Fjord in summer. Estimates of the total population size are very sensitive to the size and variability associated with the factor applied to correct aerial survey estimates for submerged animals. The maximum rate of increase is not known for beluga, but it is generally considered to be between 2-4% based on studies of other species of small whales. This lack of data on vital

rates limits opportunities to model the dynamics of this population and contributes to the uncertainty of our predictions about future population trends. Information on the number of animals struck, but lost and not reported is also needed to reduce uncertainty associated with population status and trend. Hunters in northern Quebec harvest animals from two or more populations, but uncertainty in the composition of this harvest reduces precision associated with abundance estimates. Finally, Eastern Hudson Bay belugas are also harvested by hunters from Nunavut (Sanikiluaq) and may also be harvested by hunters along the Labrador coast. Information on numbers of whales killed and stock identity of harvested animals, particularly in the latter region are limited.

CONCLUSIONS AND ADVICE

Cumberland Sound, Eastern Hudson Bay, Ungava Bay and St. Lawrence Beluga have all declined to current low levels as a result of over-harvesting. All initial declines were the result of commercial harvesting. Until recently, subsistence harvest levels have been too high to allow recovery. Current harvest levels in Cumberland Sound are low enough to allow recovery. Harvest levels in Eastern Hudson Bay are so high that they deter recovery to occur, while the Ungava Bay population may have been extirpated. Any harvesting of animals in this area will have a negative impact on the population.

Belugas in the St. Lawrence have been protected from harvesting since 1979, but have shown little sign of recovery. This may be due to low recruitment or higher than normal mortality rates in the population. Alternatively, failure to detect recovery may be due to the high variability associated with survey estimates, the short timespan in the time series (16 years), and the low rate of increase in beluga populations. Among the northern populations examined, the ability to evaluate recovery will depend upon survey efforts and the growth rates of the population.

Estimates of time to recover for the Cumberland Sound, Eastern Hudson Bay and Ungava Bay populations assume that harvesting is the only factor limiting recovery. Other factors (e.g. Allee effects), environmental variability (e.g. changes in food resources, natural predation, disease, etc.) could also be operating which would result in different recovery rates than forecast.

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