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Science Advisory Report 2012/076

HARVEST ADVICE FOR NUNAVIK BELUGA (DELPHINAPTERUS LEUCAS)

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Figure 1. Map of communities in Nunavik and limits of Nunavik Marine Region (solid line) and Equal Use and Occupancy Area (dashed line).

Context

The beluga hunt by Nunavik Inuit is important from a cultural and subsistence perspective. Current hunting targets both summering aggregations and migrating whales from a mixture of stocks, including the eastern Hudson Bay (EHB) and Ungava Bay (UB) stocks (Fig. 1). Commercial hunts removed at least 1,340 animals in Ungava Bay between the 1860s and the early 1900s, and an estimated 7,875 animals in eastern Hudson Bay between 1854 and 1863. In 2004, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recommended listing the UB and EHB stocks as Endangered.

Harvesting in Nunavik has been regulated through a combination of area closures, and seasonal and regional allowable takes. In 2006, the Nunavik Inuit Land Claims Agreement was signed, resulting in the establishment of the Nunavik Marine Region Wildlife Board (NMRWB) that has responsibilities for the co-management of Nunavik beluga. The current management plan promotes the conservation of the EHB and UB stocks but is due for review in 2012-2013. This document addresses the specific requests from DFO Ecosystems and Fisheries Management described below:

1) Evaluate the abundance of the EHB beluga stock and the impact of current harvest levels.

2) Determine the maximum harvest that maintains a 25%, 50% and 75% probability of increase for the EHB stock, taking into account the season and area of the hunt.

3) Recommend a recovery target under the precautionary approach and provide scenarios of the maximum yearly harvest EHB beluga that still provide recovery within 25 and 50 years.

SUMMARY

- Nunavik hunters harvest beluga from a mix of discrete stocks designated after their specific summering areas: Western Hudson Bay (WHB), Eastern Hudson Bay (EHB), and Ungava Bay (UB). Genetic analyses have shown that the proportion of EHB beluga in the harvest varies spatially and seasonally.
- The 2012 reported harvest consisted of 13 beluga taken in eastern Hudson Bay, 12 in Ungava Bay, 208 in Hudson Strait in the spring and 56 in the fall, 61 near Sanikiluaq (Nunavut), and 11 in the Long Island/James Bay area.
- Systematic aerial line-transect surveys to estimate abundance of beluga whales were conducted in James Bay and eastern Hudson Bay from 19 July to 18 August 2011. Unlike in previous years, the high coverage stratum in the eastern Hudson Bay was only surveyed once because of unfavourable weather conditions.
- Ungava Bay could not be surveyed in 2011 because of weather conditions. Previous assessments indicate that any harvest from the UB stock poses a threat to its recovery.
- The surface estimate for James Bay was 7,154. The abundance estimate for James Bay, after correcting for submerged beluga, was 14,967 (CV 29.9%).
- The surface abundance index for EHB was 1,434. Correcting for submerged animals and adding a count of 354 whales in the Little Whale River estuary resulted in an abundance estimate of 3,351 beluga whales (CV 48.9%) in eastern Hudson Bay.
- The 2011 abundance estimate was used to update a population model that also integrates catch data and proportions from genetic analyses. Model results suggest that the EHB stock has declined from ~4,000 whales in 1985 to ~3,000 in 2001, then has increased slightly to ~3,200 beluga in 2012.
- According to the model, removing 62 EHB animals in future harvests has a 50% probability of causing a decline in the stock, while lower harvests would likely allow some recovery. The 2012 harvest was equivalent to 59 EHB beluga.
- The EHB stock is straddling the limits of Nunavut and Nunavik. In 2012, the harvest by Sanikiluaq was 80% higher than in the previous 5 years. Although harvesting by Sanikiluaq hunters is currently closed in summer to limit the number of EHB beluga taken, changes in their harvesting practices could have an important impact on the EHB stock.
- Developing a precautionary framework would facilitate sustainable management and recovery of the EHB stock. The Precautionary Reference Level is defined as 70% of the inferred maximum stock size, which was estimated at 8,000–11,600 beluga. To encompass this range, proposed recovery targets are T1=5,600 and T2=8,000.
- Long-term projections indicate that none of the harvest scenarios can yield an 80% probability of reaching the T1 target over a 50 year timeframe. A scenario with no harvest has a 58% probability of reaching T1 in 25 years and a 35% probability of reaching T2.
- Alternative recovery targets could be based on the minimum stock size required to yield an acceptable sustainable harvest defined by resource-users. The 1985 stock size of 4,000 is not a plausible estimate of maximum stock size and should not be used to propose a recovery target.
- Projections do not include increases of other sources of anthropogenic mortality (e.g., vessel strikes and impacts of noise).

BACKGROUND

Species Biology

Beluga whales have a circumpolar distribution. They are medium-sized toothed whales with an adult length of 350 cm and weigh up to 500–600 kg. Beluga lack a dorsal fin, which is believed to be an adaptation to inhabiting ice covered waters. Mating is thought to occur during winter or early spring. Calves are born after a 14 month gestation and lactation lasts roughly 18 months. Beluga calves spend 2-3 years with their mother, during which time, they perform several seasonal migrations. It has been suggested that this extended parent-offspring association could provide the opportunity for learning migration routes. The calving interval is 3 years. At birth, the calves are brown or dark bluish in colour. The skin becomes lighter in colour as they mature, gradually turning to grey and then to white. Sexual maturity might fall between 8 and 14 years of age, and longevity may be 60+ years.

Across their entire range, beluga whales are known to visit estuaries and river mouths during summer, which has led to the view that they are a shallow water species. However, satellite telemetry data from the Little Whale and Nastapoka rivers show that beluga undertake regular trips to and from estuaries, sometimes hundreds of kilometres away, over the course of the summer.

The Harvest

Harvest statistics are available since 1974. These statistics represent minimum estimates only, since not all villages provided catch data in all years, and information on the number of animals struck and lost is incomplete. During the 12 year period 1974–1985, a total of 5,402 whales (average=450 whales/yr) was reported to have been taken by Nunavik communities. The introduction of total allowable takes (TAT) in 1986 reduced annual harvests to an average 258 beluga/yr during 1986–2001 (range: 162–385 beluga/yr), and to an average 175 beluga/yr after 2001 (range: 125–216 beluga/yr). Historically the highest reported harvests have been from Hudson Strait and this has continued with 69–92% of the total annual landings in this area since 2005 (Fig. 2).

Commercial harvests by the HBC probably initiated the depletion of beluga stocks in eastern Hudson Bay and Ungava Bay, whereas high subsistence harvests have likely limited the opportunity for stocks to recover. In the 1980's, low estimates of beluga abundance in eastern Hudson Bay and Ungava Bay resulted in limits being placed on harvesting through a combination of TAT and seasonal and regional closures, including the creation of a permanent sanctuary in southern Ungava Bay at the Whale, Mucalic, Tuctuc and Tunulic rivers (1986), and seasonal closures at the Nastapoka (1990) and Little Whale (1995) rivers in eastern Hudson Bay. Harvesting in the eastern Hudson Bay was closed from 2001 to 2006, and the Nastapoka River (NR) and Little Whale River (LWR) estuaries have remained close since harvesting resumed in the eastern Hudson Bay area in 2007. The Ungava Bay was entirely closed to hunting during four years (2002−2003, 2005−2006), and the Mucalic has remained a sanctuary since 1986.

In 2012, the Nunavik harvest was composed of 13 beluga taken in the eastern Hudson Bay, 10 in Ungava Bay in the spring and 2 in the fall, 208 in Hudson Strait in the spring and 56 in the fall, 61 near Sanikiluaq (Nunavut), and 11 in the Long Island/James Bay area.

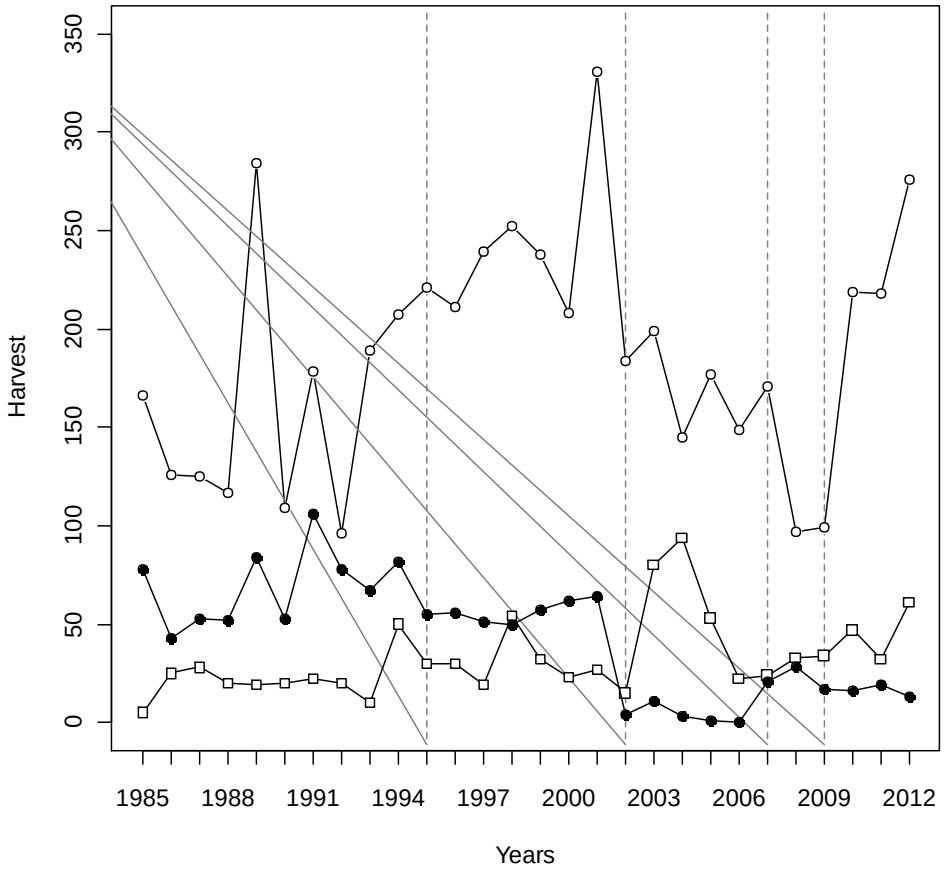

Figure 2. Beluga harvest in Nunavik for the period 1985 – 2012, broken down by region. Open circles: Hudson Strait and Ungava Bay. Closed circles: eastern Hudson Bay arc. Squares: Sanikiluaq (Belcher Islands, Nunavut). Vertical dashed lines indicate main management periods. 1985: Introduction of quotas; 1995: Seasonal closures of estuaries in eastern Hudson Bay. Puvirnituq shifts harvest from Nastapoka river to Hudson Strait; 2002: Complete closure of eastern Hudson Bay arc and Ungava Bay; 2007: Hunting resumes in eastern Hudson Bay arc and Ungava Bay, but Nastapoka, Little Whale and Mucalic river estuaries remain closed. Sanikiluaq starts restricting summer catches; 2009: Separation of Hudson Strait harvest into spring and fall periods, allowing higher total catches.

ASSESSMENT

Stock structure

According to recent genetic analyses, most beluga in Hudson Bay belong to the same breeding population. However, evidence from photo-identification, genetic and contaminant research show that beluga exhibit fidelity to specific aggregation areas in summer. Telemetry studies in Nunavut and Nunavik have supported the concept that Nunavik hunters harvest beluga from a mix of several discrete stocks, designated after these summering areas: western Hudson Bay (WHB), eastern Hudson Bay (EHB), and Ungava Bay (UB). In the winter, these stocks are found in Hudson Strait, Ungava Bay, the Labrador Sea and southwest Davis Strait where they are believed to interbreed.

Eastern Hudson Bay (EHB)

Although some individuals are observed from land in late May, most EHB beluga arrive in eastern Hudson Bay around June-July. Their spring migration route has not been documented

but genetic analyses suggest that about 12% of the whales harvested by southern Hudson Strait communities in the spring belong to the EHB stock. Satellite telemetry indicates that whales from the Little Whale and Nastapoka rivers leave the eastern Hudson Bay arc between early-October and mid-November and migrate along the southern Hudson Strait shore to Ungava Bay and the Labrador Sea. Their proportion in the fall harvest in Hudson Strait is estimated at 21%.

Ungava Bay (UB)

Beluga were historically abundant in Ungava Bay. Although the major summer concentrations of beluga formerly found in southern Ungava Bay are no longer observed, continued sightings and occasional harvesting suggest either that the stock persists at some low level or that the area is frequented by whales from neighbouring stocks. The proportions of EHB beluga in harvest samples from the five communities in Ungava Bay as well as Quaqtaq have been estimated by genetic analyses at 4% ± 5% in spring, 6% ± 9% in summer, and 28% ± 9% in the fall. The high proportion of EHB beluga in the fall is consistent with satellite telemetry data showing that EHB beluga migrate through Ungava Bay during their fall migration, arriving in October or November.

James Bay (JB)

Most beluga whales migrate long distances between wintering and summering locations. However, information from traditional knowledge and satellite telemetry suggest that some beluga whales remain in James Bay for the winter. Genetic analyses of whales sampled in James Bay have confirmed that these beluga form a separate breeding population, distinct from other management stocks in Hudson Bay.

Belcher Islands

Beluga whales are harvested mostly during spring and fall around the Belcher Islands, which lie in the centre of the arc of eastern Hudson Bay. Their relationship to other summer stocks remains unclear. Satellite telemetry has shown that EHB beluga from the Little Whale and Nastapoka rivers use offshore areas in eastern Hudson Bay that extend into both the Nunavut Settlement Area and the Equal Use and Occupancy Area, including the Belcher Islands. Genetic analyses have shown that beluga harvested near Sanikiluaq (Belcher Islands, Nunavut) are of mixed origin. Haplotype composition of samples from animals harvested during spring/early summer indicates that EHB animals represent about 12% of the Sanikiluaq harvest.

Abundance and impact of harvest levels

Systematic aerial line-transect surveys to estimate abundance of beluga whales were conducted in James Bay and eastern Hudson Bay from 19 July to 18 August 2011. The flights followed east-west lines with a spacing of 18.5 km in all strata except in the central portion of eastern Hudson Bay, a high coverage area where spacing was reduced by half, *i.e.* 9.3 km. Unlike in previous years, this stratum could not be surveyed twice because of unfavourable weather conditions.

Eastern Hudson Bay (EHB)

No animal was seen in the low coverage area of eastern Hudson Bay. There were 63 beluga groups detected in the high coverage area of eastern Hudson Bay (Fig. 3), with an average size of 3.21 individuals, resulting in a surface abundance index of 1,434. Correcting for submerged

animals and adding a count of 354 whales in the Little Whale River estuary resulted in an abundance estimate of 3,351 beluga whales (CV 48.9%) in eastern Hudson Bay.

The relatively high CV in 2011 is due to the uneven distribution of beluga among lines. This is a common source of uncertainty when conducting census of small populations with clumped distributions.

Abundance estimates of the EHB stock from previous aerial surveys have varied widely and are characterized by wide confidence intervals (Fig. 4). A population model incorporating updated information on harvest statistics and stock composition was fitted to aerial survey estimates using Bayesian methods. Model results indicate that the EHB stock has likely declined from ~4,000 whales in 1985 to ~3,000 in 2001, then has increased slightly to ~3200 beluga in 2012.

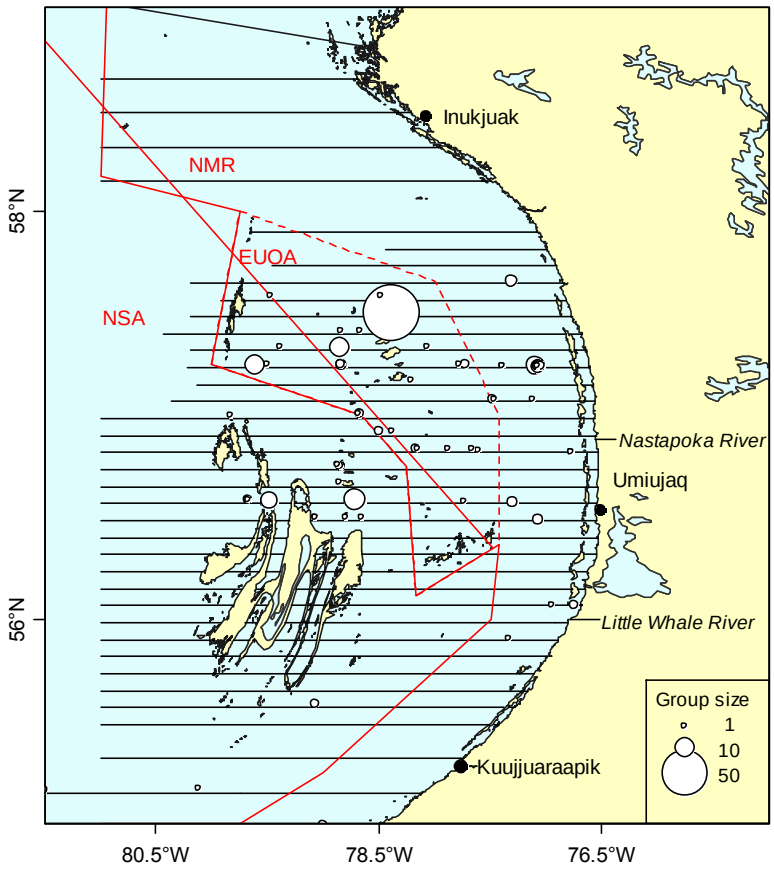

Figure 3. Distribution of detected clusters and lines surveyed in eastern Hudson Bay. NSA: Nunavut Settlement Area. NMR: Nunavik Marine Region. EUOA: Equal Use and Opportunity Area.

According to the model, removing 62 EHB animals per year for 10 years would have a 50% probability of causing a decline in the stock relative to its 2012 estimate (Fig. 5). Limiting the harvest of EHB animals to 28 animals would reduce the probability of decline to 25%. Conversely, a harvest of 106 EHB beluga would have a 75% probability of leading to stock decline. In the absence of harvest, the probability of decline is 9%. The total impact of harvesting on the EHB summer stock will depend on the actual number of animals killed in the eastern Hudson Bay arc area and the proportion of animals taken during spring/summer vs. fall in Hudson Strait.

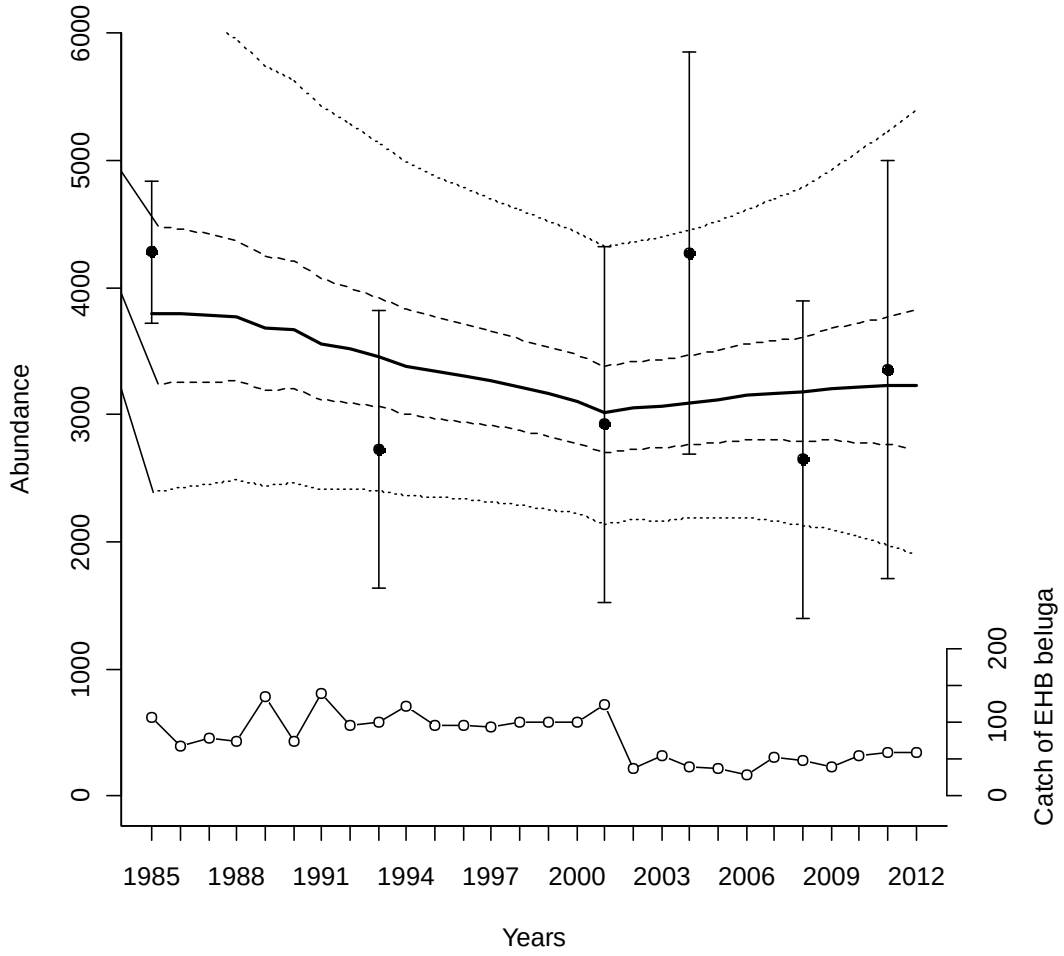

Figure 4. Eastern Hudson Bay beluga. Model estimates of stock abundance. Solid line: median estimates. Dashed lines: 25% and 75% quartiles. Dotted lines: 2.5% and 97.5% quantiles (= 95% Bayesian Credible Interval). The model was fitted to aerial survey estimates corrected for animals at the surface (closed circles, ±SE). Right y-axis: Catch of EHB beluga based on the catch series of different regions in Nunavik multiplied by the estimated proportions of EHB whales in each harvest (open circles).

Ungava Bay (UB)

Ungava Bay could not be surveyed in 2011 because of weather conditions. No whales were counted on transect lines during four systematic aerial surveys of Ungava Bay flown in 1985, 1993, 2001, and 2008. According to previous assessments, there is a strong probability that there are less than 100 individuals in the UB stock.

James Bay (JB)

A total of 173 beluga groups with an average size of 3.38 were detected in James Bay (Fig. 6) providing a surface abundance index of 7,154. The abundance estimate for James Bay, after correcting for submerged beluga, was 14,967 (CV 30%).

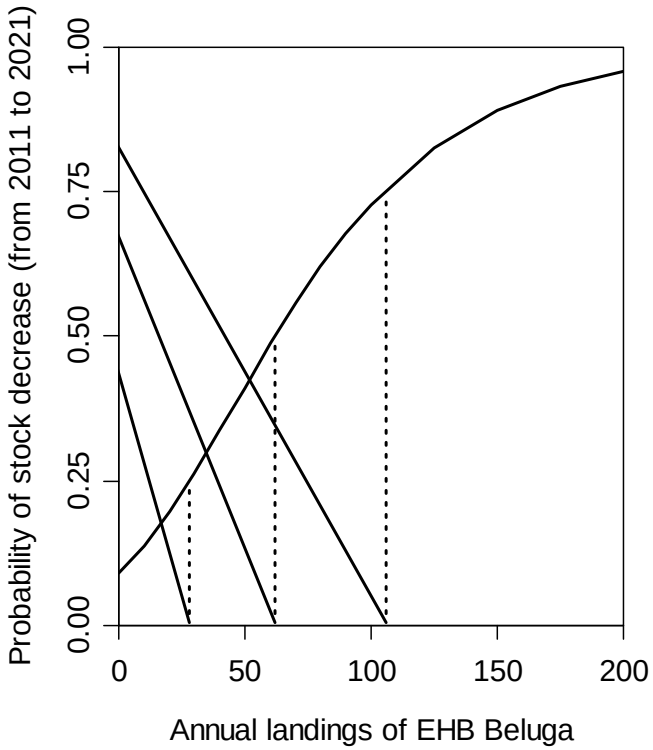

Figure 5. Probability of EHB beluga stock decrease from the 2012 abundance estimate after 10 years of harvest, as a function of the number of EHB beluga removed from the stock every year. Dotted lines indicate levels of harvest corresponding to 25%, 50% and 75% probability of decline.

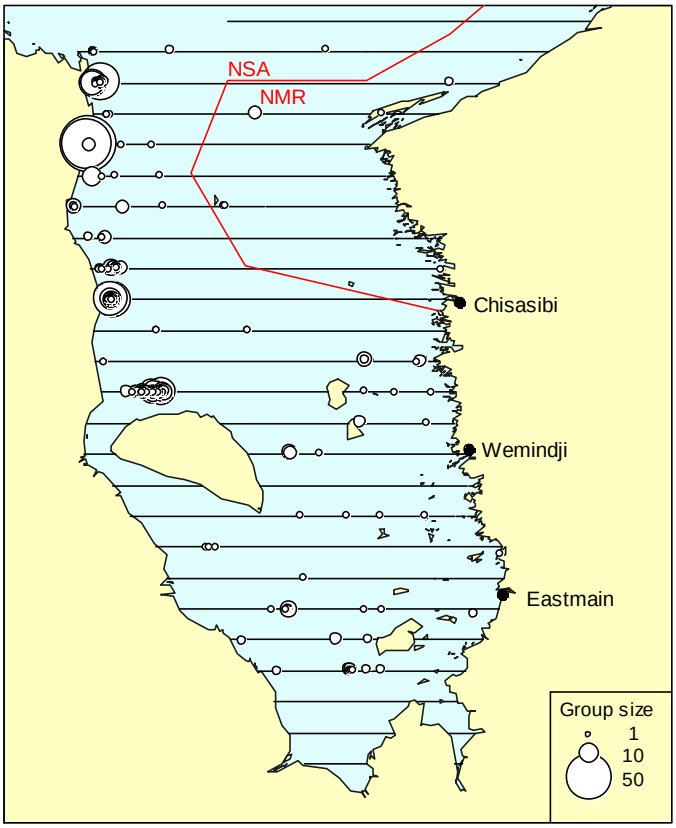

Figure 6. Geographic distribution of detected clusters and lines surveyed in James Bay. NSA: Nunavut Settlement Area. NMR: Nunavik Marine Region. EUOA: Equal Use and Opportunity Area.

Precautionary approach

Harvest advice in Nunavik is based on the best available information on the status of the EHB stock. However, there is uncertainty in survey estimates, population dynamics and harvest composition. Failure to recognize the importance of this uncertainty can lead to severe harm to populations. The Precautionary Approach (PA) strives to be more cautious when information is less certain and defines decision rules for stock management when the resource reaches clearly-stated reference points. The limit (or critical) reference point (N_{lim}) represents the estimated level at which continued removals would lead to serious harm to the population. The Precautionary Reference Level (PRL) identifies a population range within which risk averse management control rules would apply to ensure that the population does not fall below the critical reference level.

The PRL, defined as 70% of the observed or inferred maximum population size, has been identified as the recovery target for EHB beluga. Pristine stock size (pre-1854) is unknown, but was estimated at 8,000 – 11,600, based on commercial catch records. Therefore, two recovery targets are proposed to encompass this range: T1=5,600 and T2=8,000. These targets follow the framework that has been proposed for other marine mammals in Canada. This framework also identifies a reference limit point at 30% of the maximum population size (N_{lim}), i.e., about 2,400 if the lower estimate of maximum population size is used. The probabilities of reaching T1 and T2 after 25 and 50 years for several annual harvest levels are given in Table 1.

Table 1. Probability of reaching the recovery targets after 25 or 50 years, under different annual harvest levels of EHB beluga .

harvest	T1 = 5,600		T2 = 8,000	
	25 yrs	50 yrs	25 yrs	50 yrs
0	58%	78%	35%	66%
10	53%	72%	31%	61%
20	48%	66%	28%	55%
30	42%	60%	25%	50%
40	38%	54%	22%	44%
50	33%	48%	19%	39%
60	29%	42%	16%	34%
70	25%	36%	14%	29%
80	22%	31%	12%	25%
90	19%	26%	10%	22%
100	16%	22%	9%	18%
125	11%	14%	6%	12%
150	7%	9%	4%	7%
175	4%	5%	2%	4%
200	3%	3%	2%	3%

Sources of uncertainty

Abundance estimates for these summer stocks are limited to six aerial surveys. There is uncertainty associated with these survey estimates, which results from the clumped distribution of whales. Other factors include the variability in surfacing behaviour of the whales; aerial survey estimates were corrected for animals that were diving when the survey plane passed overhead, but estimates of abundance are very sensitive to this correction factor which is based on limited data. Fitting a population model to the data helped to reduce some of the uncertainty around the estimated current stock size.

There is little information about the number of animals wounded but not recovered (i.e., the struck and lost factor). The value of 4% reported by hunters in 2012 was included in the range of possible values given to the model, but was not supported by the data. Modeling suggests that this factor, which also encompasses under-reporting, is closer to 40% of the landed catch.

There is also a lack of data on vital rates, which limits opportunities to model the dynamics of this stock. More frequent surveys would reduce some of the uncertainty, as would increased participation in the sampling program and improvements in field observations of actual struck-and-loss rates.

There are several additional sources of uncertainty in the PA analysis. First, the recovery targets depend on our estimates of the historical maximum stock size, which were based on 10 years of commercial harvest reports and assumptions regarding population dynamics and the number of beluga remaining after 1864. There is considerable uncertainty regarding these estimates. Moreover, ecological conditions present in the 1800's may no longer apply to current environmental conditions. Eastern Hudson Bay has undergone several changes (geostatic rebound, reduction in ice cover, changes in fish abundance and composition) that may have had an effect on carrying capacity. The impacts of climate change and environmental variability on this stock are not well understood. Moreover, future projections were developed using a model that does not include a mechanism for density-dependence, and therefore might not

provide an accurate representation of population dynamics in the vicinity of the carrying capacity.

The abundance of marine mammal populations is influenced by a variety of factors impacting mortality, which incorporates natural and anthropogenic sources. Negative consequences to beluga populations could arise from the noise and ship strikes associated with future industrial activities. For example, the Mary River Project is a proposed iron ore mine located on North Baffin Island, in the Qikiqtani Region of Nunavut. This project will include year-round shipping of iron ore to Europe and will require a large fleet of vessels with ice breaking capabilities. There are several proposals that will ultimately result in greatly increased shipping in Nunavik and adjacent waters. Studies suggest impacts of this increased vessel traffic and icebreaking on beluga will not be negligible, which might ultimately result in decreased sustainable harvest levels.

ADDITIONAL STAKEHOLDER PERSPECTIVES

The Inuit in northern Quebec consider beluga whales as an important food resource. There is community concern regarding contaminants and disease agents that could affect the health of beluga or their human consumers. Other global issues of concerns include climate change and the resultant changes in sea ice, which might affect whale movements, their foods and hunter access to whales. Community consultations raised concerns about the increase in numbers of both small boats and large ships, and how increasing noise might disturb beluga, particularly in nearshore areas.

A wide range of concerns have been expressed about beluga whale abundance. Some people have difficulty understanding and accepting survey estimates, since they have seen large numbers of whales in areas where only small numbers of whales have been seen during the survey period. Several people expressed concern that they were seeing fewer animals than in the past. It is not clear whether changes in sightings are a result of a reduction in beluga abundance, or animals having moved elsewhere. Some communities in EHB have also expressed that there are fewer whales today than during previous years due to high harvest levels. However, other communities particularly in Hudson Strait feel very strongly that beluga are abundant. Moreover, some hunters disagree with the scientific view that female beluga whales have a calf every three years on average, believing instead that beluga females have a calf every year.

CONCLUSIONS AND ADVICE

The current size of the EHB summer stock is estimated at around 3,200. The population trajectory shows that the EHB stock continued to decline steadily even after quotas were enacted in the mid-1980s, because management measures failed to reduce catches in the eastern Hudson Bay arc. In 1995, seasonal closures of estuaries in eastern Hudson Bay forced several communities to shift their harvest to Hudson Strait, but only during certain months. Population modeling suggests that this management strategy did not slow the decline in stock abundance, perhaps because whales could be caught immediately before or after the seasonal closures. Only since the 2002 complete closure of the eastern Hudson Bay arc does there seem to have been a sustained reduction in EHB catches and some stabilization in the stock. In 2007, hunting resumed in eastern Hudson Bay arc, but its main estuaries (Nastapoka and Little Whale River) remained closed, and most villages had to continue taking their quotas from the Strait. This strategy appears to have been effective at maintaining EHB beluga catches at low levels.

Recent management schemes separating the Hudson Strait harvest into spring and fall periods have allowed higher total catches without increasing the catch of EHB whales. In recent years, the stock seems to exhibit slow growth.

The 2012 harvest was equivalent to 59 EHB beluga. This increase from last year (55 EHB) was mostly due to the increase of the Sanikiluaq harvest (61 vs. 32 in 2011). Genetic analyses have shown that 12% of whales harvested in the Belcher Islands belong to the EHB stock. The increase in the 2012 Sanikiluaq harvest thus represents an additional 3 or 4 EHB beluga. These whales are included in the model and thus affect harvest advice for subsequent years. Currently, the harvest in Sanikiluaq is monitored but not controlled, except for a municipal motion prescribing that whales should be taken before July 15th or after September 30th. An earlier version of the municipal motion stopped hunting at the beginning of July, which minimized the impact on the EHB stock because of the low proportions of EHB whales in the spring and fall. The recent changes in harvest dates may have made EHB animals more vulnerable.

The total impact of harvesting on the EHB summer stock depends on the actual number of beluga killed in the eastern Hudson Bay arc and around Sanikiluaq, and on the proportion of the Nunavik harvest taken during spring/summer vs. fall in Hudson Strait and Ungava Bay. Removing 62 EHB whales in future harvests would have a 50% probability of causing a decline in the stock. Limiting the harvest of EHB animals to 28 would reduce this probability to 25%. A spring/summer harvest in Hudson Strait, with no harvest in the eastern Hudson Bay arc would have the lowest impact on the EHB stock, followed by a fall harvest in Hudson Strait only. If harvesting does occur in eastern Hudson Bay, then numbers taken in Hudson Strait must be reduced to obtain the same probability of increase, but the size of this reduction will depend on whether hunting occurs in the spring/summer or in the fall.

Based on a combination of genetic and telemetry studies, beluga in James Bay are considered a separate stock. The 2011 abundance estimate for James Bay, after correcting for submerged beluga, was 14,967. Its CV of 30% is comparable to that of previous years (24%–30% for 1993–2004) and lower than that of 2008 (66%). The 2011 estimate supports the possibility that the JB population falls in the higher range of the previous estimates (> 10,000, as suggested by the 2001 and 2008 surveys) rather than the lower range (< 10,000, as suggested by the 1985, 1993 and 2004 surveys).

Ungava Bay could not be surveyed in 2011 because of weather conditions. Previous assessments have indicated that any harvest from the UB stock poses a threat to its recovery. In 2012, 10 beluga were taken in Ungava Bay during the summer period and 2 during the fall. A summer hunt minimizes the amount of EHB beluga killed but increases the probability of taking UB beluga.

Setting catches at levels that result in a 50% risk to the EHB stock makes rebuilding the resource even to levels observed in the early 1980s uncertain. Developping a precautionary framework would facilitate sustainable management of Nunavik beluga and recovery of this stock. Two recovery targets based on the inferred maximum stock size were proposed. Depending on which estimate of maximum stock size is used, T1=5,600 and T2=8,000. These targets follow the framework that has been proposed for other marine mammals in Canada. The recent observed maximum of 4,000 should not be considered a plausible estimate of maximum stock size and should not be used to propose a recovery target.

The key element within PA is the avoidance of serious harm to the resource. Consequently, uncertainty associated with population estimates is considered when identifying the probability

of reaching the recovery target. Under the proposed framework for marine mammals, there must be an 80% probability that the population will be above the PRL in order to consider that a population has recovered. Our long-term projections indicate that none of the harvest scenarios (even zero harvest) can meet this requirement over a 50 year timeframe. A scenario with no harvest has a 58% probability of reaching T1 in 25 years. Alternative recovery targets could be based on the minimum stock size required to yield an acceptable sustainable harvest that would be defined by resource-users.

OTHER CONSIDERATIONS

Beluga in northern Quebec are co-managed with the Nunavik Marine Region Wildlife Board (NMRWB) under a multi-year management plan. While the NMRWB has management responsibilities as outlined in the Nunavik Inuit Land Claims Agreement, DFO retains ultimate responsibility for the management of all marine species.

COSEWIC has identified this stock as endangered, but no decision has been made by the Government of Canada pending the establishment of a consultation framework with the Nunavik Marine Region Wildlife Board for SARA issues.

SOURCES OF INFORMATION

This Science Advisory Report is from the October 29 to November 2, 2012 Annual meeting of the National Marine Mammal Peer Review Committee. Additional publications from this process will be posted as they become available on the Fisheries and Oceans Canada Science Advisory Schedule at www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

Doniol-Valcroze, T., Gosselin, J.-F. and Hammill, M.O. 2013. Population modeling and harvest advice under the precautionary approach for eastern Hudson Bay beluga (*Delphinapterus leucas*). DFO Can. Sci. Advis. Sec. Res. Doc. 2012/168. iii + 31 p.

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Turgeon, J., P. Duchesne, G. Colbeck, L. D. Postma, and M. Hammill. 2012. Spatiotemporal segregation among summer stocks of beluga (*Delphinapterus leucas*) despite nuclear

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FOR MORE INFORMATION

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