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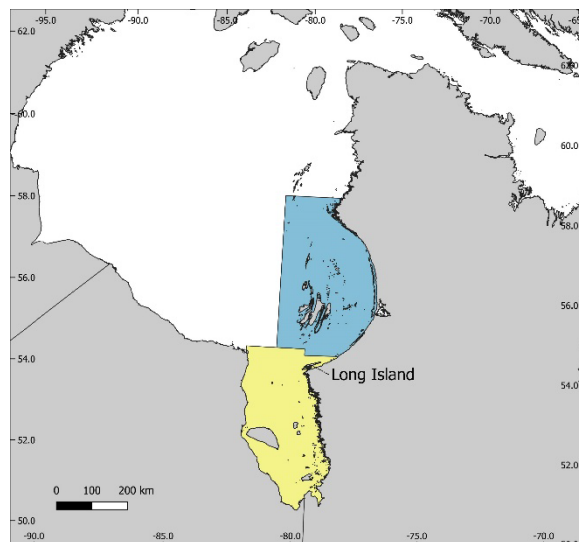
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Quebec and Arctic Regions

## STOCK ASSESSMENT OF BELCHER ISLANDS-EASTERN HUDSON BAY AND JAMES BAY BELUGA (*DELPHINAPTERUS LEUCAS*) IN 2024



*Beluga Whales (Delphinapterus leucas) (DFO)*



*Figure 1. The Belcher Islands-Eastern Hudson Bay (blue) and James Bay (yellow) strata covered during the 2024 aerial survey. These fully encompass the summer distribution of the Belcher Islands-eastern Hudson Bay (BEL-EHB) and James Bay (JAM) beluga stocks.*

### CONTEXT

Beluga hunting is very important for Nunavik communities both from a cultural point of view and in terms of community food security. Nunavik hunters harvest belugas from at least four stocks: Belcher Islands-Eastern Hudson Bay (BEL-EHB), Western Hudson Bay (WHB), Ungava Bay (UNG) and James Bay (JAM).

Harvesting of BEL-EHB beluga by Nunavik communities is managed under a multi-year management plan developed by the Nunavik Marine Region Wildlife Board (NMRWB) and the Eeyou Marine Region Wildlife Board (EMRWB), and reviewed for acceptance or variation by the Minister of Fisheries and Oceans Canada. The current 5-year management plan (2021-2026) objective is to ensure a 50% or greater probability that the stock will remain at or above 3,400 EHB beluga after five years. The plan intends to meet this objective through a combination of non-quota limitations (regional and seasonal closures) and quota limitations in the Eastern Hudson Bay management zone.

Beluga stock assessment in Nunavik relies on the estimation of abundance of beluga in their summering habitat, and on an understanding of stock composition of the harvest, which varies both seasonally and spatially. The 3,400 threshold in the management plan was established based on the best available science when the management plan was developed in 2021 (DFO 2020). At that time, the BEL-EHB beluga stock (referred to as EHB beluga in the current management plan) was estimated to be slightly increasing or stable with an abundance of 3,400 in 2016. However, since then, improvements in survey analysis methods, an additional aerial survey estimate from 2021, and a genetic re-analysis changed our understanding of stock structure and demographic trend. As a result, the entire abundance time series was recalculated, making the 3,400 individual benchmark for assessing impacts of the harvest on the population outdated. The last BEL-EHB stock assessment also indicated that the stock has been declining at a rate of 2.5 to 3% per year since 2015, changing our perspective on the BEL-EHB stock dynamics.

In light of these considerations, and the expiration of the current management plan in January 2026, a new survey of BEL-EHB and JAM beluga was conducted in summer 2024. In addition, a new integrated population model optimizing the use of available information from sampled beluga, and accounting for unexplained sources of variation in population dynamics (i.e., environmental stochasticity) has been developed.

DFO Science was requested to review the 2024 aerial survey abundance estimates and trends for the BEL-EHB and JAM stocks, to conduct an assessment of the status of the BEL-EHB stock using the most recent information on genetic composition of the harvest, and to provide advice on the maximum level of harvest that maintains the stock at a stable level or increases it to different target levels. A request was also made to provide potential biological removals (PBR) for both BEL-EHB and JAM stocks.

This Science Advisory Report is from the regional peer review of February 10-12, 2025 on Population Assessment and Advice on Beluga Harvest in Eastern Hudson Bay and James Bay. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

## SUMMARY

- Total harvest in Nunavik has ranged between 366 and 681 beluga per year during 2021-2024. In Sanikiluaq (Belcher Islands, Nunavut), harvest has ranged from 20 to 51 beluga per year.
- Based on genetic analysis and season- and area-specific distribution of the beluga hunt, on average, 126 and 23 beluga from the BEL-EHB stock were harvested by Nunavik and Sanikiluaq hunters between 2021-2024, respectively. For the JAM stock, the Nunavik and Sanikiluaq harvest levels are estimated at 27 and 6 beluga over the same period.
- The spatial- and seasonal distribution of the harvest under the current management plan results in 3.8 beluga being harvested for each BEL-EHB landed. Alternate scenarios would increase or decrease this ratio.
- The 2024 survey abundance estimate, corrected to account for the proportion of animals missed at the surface or underwater during the aircraft overpass, was 1,500 (95% CI= 900-2,400) (rounded to the nearest 100) for the BEL-EHB stock. This 2024 estimate is the lowest and most precise in the time series of comparable surveys flown since 1985.

- The 2024 corrected survey abundance estimate for the JAM stock was 11,500 (95% CI=7,300-17,900).
- A Bayesian Integrated Population model was developed for the BEL-EHB stock using six sources of information (aerial surveys, harvest levels, genetic composition of the harvest, reproductive rates, age and sex structure, and proportion of lactating females) to estimate abundance trends and the impact of various harvest scenarios.
- For the BEL-EHB stock, the model estimated carrying capacity at 8,100 (95% CrI = [6,800; 10,300]) and a 2024 abundance of 2,200 (95% CrI = [1,800; 2,500]) beluga. Following a period of apparent stability (2001-2013), the stock is estimated to have been declining, with an average rate of decline of 5.1% per year (95% CrI = [3.6; 7.2]) since 2021.
- The 2021-2026 management plan objective for the BEL-EHB stock is to ensure a 50% probability that the stock will be at or above 3,400 animals after 5 years. Based on the 2024 estimate of stock abundance and trend, no harvest level of BEL-EHB beluga would respect this objective.
- The maximum number of BEL-EHB beluga that could be harvested annually to ensure 50%, 80% and 95% probabilities that the stock remains stable to its 2024 abundance are 50, 43, and 35 BEL-EHB beluga, respectively.
- Under the Maximum Sustainable Yield (DFO-MSY) Precautionary Approach framework, the Limit Reference Point (LRP) for the BEL-EHB stock is estimated at 1,900 beluga and the Precautionary Reference Point (PRP) at 3,900 beluga. Considering the 2024 estimate, there is a 100% probability that it is below the PRP and a 89% probability that the stock is above the LRP. Therefore, the stock is considered in the Cautious Zone.
- Model projections indicate that if current BEL-EHB beluga harvest levels are maintained, the stock is expected to decrease to a state of quasi-extinction (i.e., less than 50 mature females) with 50% to 95% probabilities by 2037 to 2039.
- Annual harvest levels not exceeding 88, 66, and 55 BEL-EHB beluga would allow the BEL-EHB stock to reach or surpass the LRP with a 50% probability in 5, 10 and 25 years.
- The potential biological removal (PBR) for the BEL-EHB beluga stock was estimated at 4 beluga per year.
- The IPM approach was applied to the JAM beluga stock. Two sources of information (aerial surveys, harvest levels) were used to fit the model and estimate abundance and demographic trends.
- The model estimated a carrying capacity of 18,300 and a population abundance in 2024 of 16,000 (95% CrI = [12,300; 20,600]) beluga for the JAM stock. Following a period of increase, the stock is estimated to have remained stable close to carrying capacity since 2010.
- Under the DFO-MSY Precautionary Approach framework and considering the 2024 estimate, there is a 100% probability that the JAM stock is above the PRP (8,800 beluga), i.e., in the Healthy Zone.
- The PBR for JAM was estimated at 245 beluga per year.
- Harvest levels exert a large influence on the IPM results for the BEL-EHB stock. However, there remains a high level of uncertainty in the number of animals struck and killed but not recovered or non-reported, and in how these may have varied over time.

## BACKGROUND

The beluga has a nearly circumpolar range in the Arctic and subarctic. In Canada, beluga stocks have been identified based primarily on the disjunct distribution of summering aggregations. These stock separations have been supported by evidence for strong intra- and inter-annual fidelity to summering areas and migration routes, which are thought to be learned through the cultural transfer of information from females to calves. These characteristics make beluga more vulnerable to local extinction and may reduce their ability to adapt to local changes and re-colonize areas where they are extirpated.

### The Harvest

#### James Bay (JAM) stock

Historically, efforts to develop commercial whaling in James Bay were not successful and removals appear to have been insignificant. Consequently, the JAM population was never depleted to the extent seen elsewhere. Significant habitat changes have occurred through very large-scale hydroelectric developments on the east side of James Bay, but their long-term impacts are not known. In recent times, there has been limited hunting. Reported removals in 2024 were 4 belugas.

#### Belcher Islands and Eastern Hudson Bay (BEL-EHB) stock

Commercial harvests in the 19<sup>th</sup> century initiated the depletion of beluga in eastern Hudson Bay. Subsequent subsistence harvests may have limited recovery. In the 1980's, limits were placed on harvesting through a combination of Total Allowable Takes (TAT) in Nunavik and regional and seasonal closures at the Nastapoka and Little Whale rivers. Harvesting in eastern Hudson Bay was closed from 2001 to 2006, and the Nastapoka and Little Whale rivers estuaries have remained closed since harvesting resumed in eastern Hudson Bay in 2007. In 2024, a total of 681 beluga were reported harvested by Nunavik, including the 4 animals from the Long Island area with another 48 animals harvested by the Sanikiluaq community (Nunavut) (Table 1). The 2024 harvest in Nunavik was the highest in the time series since the 1970s, and based on season- and management area-specific genetic stock composition, 182 of these whales were BEL-EHB beluga (Table 1). For reference, the harvest threshold identified in the current management plan for Nunavik is 58 BEL-EHB beluga per year.

*Table 1. Annual number of beluga reported to have been harvested across Nunavik and by the Sanikiluaq (SAN) community (Nunavut), along with the harvest numbers specific to BEL-EHB and JAM beluga calculated from season- and management area-specific genetic stock composition of the harvest.*

Year	Total Nunavik	Total SAN	TOTAL BEL-EHB Nunavik	TOTAL BEL-EHB SAN	TOTAL JAM Nunavik	TOTAL JAM SAN
1974	605	0	270	0	6	0
1975	810	0	344	0	9	0
1976	679	0	310	0	7	0
1977	823	14	382	9	8	2
1978	407	6	213	4	4	1
1979	564	0	329	0	4	0
1980	561	0	336	0	4	0
1981	333	6	145	4	3	1
1982	385	30	169	20	4	3

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Hudson Bay and James Bay Beluga in 2024**

**Quebec Region**

<b>Year</b>	<b>Total Nunavik</b>	<b>Total SAN</b>	<b>TOTAL BEL-EHB Nunavik</b>	<b>TOTAL BEL-EHB SAN</b>	<b>TOTAL JAM Nunavik</b>	<b>TOTAL JAM SAN</b>
1983	332	7	151	5	3	1
1984	320	28	169	18	3	3
1985	269	5	137	3	2	1
1986	169	25	69	16	2	3
1987	178	28	79	18	2	3
1988	169	20	76	13	2	2
1989	368	19	142	12	4	2
1990	162	20	75	13	2	2
1991	284	22	142	14	3	3
1992	174	20	97	13	1	2
1993	256	10	106	7	3	1
1994	289	50	124	33	3	6
1995	276	30	101	20	3	3
1996	267	30	99	20	3	3
1997	290	19	100	12	3	2
1998	302	54	102	35	4	6
1999	295	32	106	21	3	4
2000	270	23	105	15	3	3
2001	380	27	124	18	5	3
2002	179	15	39	10	3	2
2003	202	80	43	52	3	9
2004	151	94	33	61	2	11
2005	178	53	37	35	3	6
2006	149	22	31	14	2	3
2007	192	24	55	16	2	3
2008	120	33	42	21	1	4
2009	165	34	54	22	2	4
2010	230	47	56	31	3	5
2011	237	32	64	21	3	4
2012	289	61	61	40	5	7
2013	256	76	59	49	3	9
2014	298	26	71	17	11	3
2015	303	170	98	111	12	20
2016	225	43	42	28	41	5
2017	299	30	74	20	11	3
2018	378	50	92	33	12	6
2019	367	28	114	18	34	3
2020	430	46	106	30	34	5
2021	366	30	141	20	50	3
2022	384	51	80	30	21	9
2023	532	20	127	13	18	3
2024	681	48	154	28	19	8

### The DFO Maximum Sustainable Yield (MSY) Framework

The DFO-MSY Precautionary Approach identifies a Limit Reference Point (LRP) and a Precautionary Reference Point (PRP) calculated based on MSY. The MSY is defined as 60% of the stock's carrying capacity, whereas the LRP and PRP are defined as 40% and 80% of the MSY. From these benchmarks, three zones of resource concern are defined (DFO 2006). A stock is considered to be in the Healthy Zone if there is at least a 50% probability that its abundance lies above the PRP, whereas it is considered in the Critical Zone if there is a 50% probability that the stock abundance is below the LRP. Finally, a stock is considered to be in the Cautious zone if its abundance lies between the LRP and PRP (Hammill et al. 2017). Within this framework, the objective is to manage exploitation of the resource so that it remains in the healthy zone.

The BEL-EHB and JAM beluga stocks are not currently managed under the Precautionary Approach. Nevertheless, the DFO-MSY reference points are included in this assessment as benchmarks to contextualize the status of these stocks.

## ASSESSMENT

### Aerial surveys

Visual line-transect surveys flown in July-September 2024 covered James Bay, Tasiujaq Lake (formerly Richmond Gulf) and the eastern Hudson Bay from the coastline to 81°W of longitude, which is 60 km west of the Belcher Islands (Figure 1). Surveys were also flown along the coastline from Long Island to North of Inukjuak and in the Nastapoka and Little Whale River estuaries to search for beluga aggregations. The Nastapoka and Little Whale rivers were specifically targeted and visited every time a transit was passing by, weather permitting.

In 2024, no surveys were flown in Ungava Bay nor in the west of Hudson Bay.

Data from the 2024 survey were analyzed by fitting a gamma detection curve to ungrouped perpendicular distances to estimate surface abundance indices. Gamma functions optimize the use of existing data when maximum probability of detection is away from the track line, as is the case in an aircraft. To facilitate comparability with previous survey estimates, the entire time series of aerial survey abundance estimates (i.e., 1985-2021; Table 2) has been revised, using a gamma key function upon fitting the detection curve in distance sampling analyses.

*Table 2. Aerial survey abundance estimates (est.) and standard error (SE) for the BEL-EHB, Western Hudson Bay (WHB), James Bay (JAM) and Ungava Bay (UB) beluga stocks from aerial surveys. Indices have been corrected for availability and perception bias.*

Year	BEL-EHB (SE)	WHB (SE)	JAM (SE)	UNG (SE)
1985	4,497 (1,168)	-	4,788 (1,525)	*
1987	-	31,124 (6967)	-	-
1993	2,504 (961)	-	7,573 (1,985)	*
2001	2,634 (1,166)	-	17,958 (4,477)	*
2004	5,069 (1,686)	51,761 (15,875)	17,930 (4,238)	-
2008	4,326 (2938)	-	25,686 (18,175)	*
2011	4,681 (2,064)	-	22,063 (6,536)	-
2015	8,506 (4,341)	54,473 (5,329)	22,847 (7,557)	-
2021	2,858 (814)	-	14,427 (3,427)	-

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Year	BEL-EHB (SE)	WHB (SE)	JAM (SE)	UNG (SE)
2022	-	-	-	68 (41)
2024	1,491 (366)	-	11,455 (2,650)	

\* No beluga have been seen on transect in Ungava Bay during the 1985, 1993, 2001 and 2008 surveys.

### Modeling abundance of beluga and impact of harvest

An age and stage structured Bayesian Integrated Population Model (IPM) was developed for the BEL-EHB beluga stock. The model includes six sources of information to produce stock abundance estimates and trends: 1) abundance from aerial surveys, 2) pregnancy rates, 3) harvest numbers, 4) genetic composition of the harvest, 5) harvest sex and age structure, and 6) proportion of adult females lactating in the harvest. In addition, the model includes annual stochasticity, allowing for a more realistic picture of annual fluctuations in abundance and the estimation of the relative contribution of harvest to overall mortality.

The new IPM was used to provide an updated estimate of BEL-EHB stock abundance for 2024 and harvest advice. Abundance of the BEL-EHB stock in 2024 was estimated at 2,200 (95% CrI = [1,800; 2,500]) beluga (Figure 2). The model estimates that after a period of stability from approximately 2001 – 2014, the population has since declined. Since 2021, the estimated rate of decline for the BEL-EHB beluga stock is 5.1% (95% CrI = [3.6; 7.2]). The average number of BEL-EHB beluga harvested per year is estimated at 140 for this period, with the 2024 estimate being 183. The estimated contribution of harvest to overall mortality also increased since 2021 and reached 63% (95% CrI = [51, 77]) in 2024.

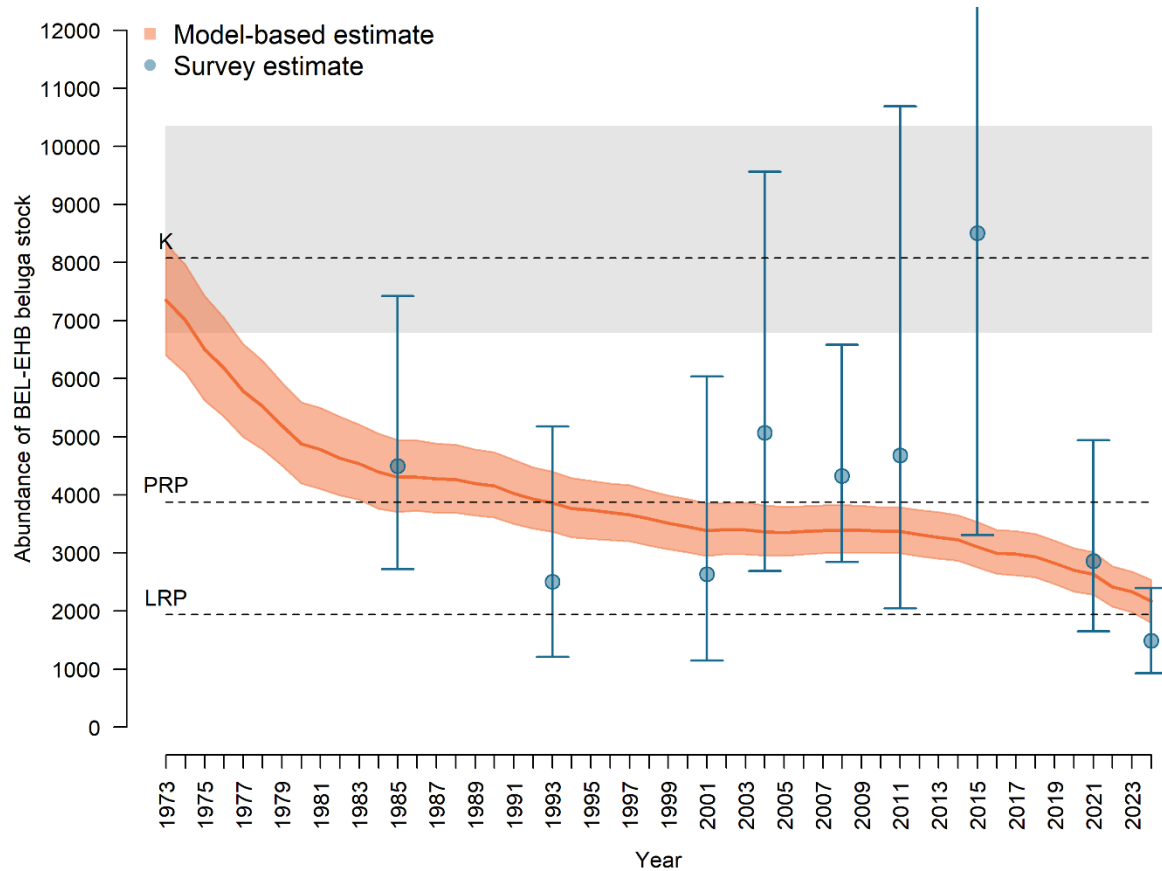


Figure 2. Demographic trend for the BEL-EHB beluga stock. Abundance (mean: dark orange line, 95% Credible Interval: light orange polygon) is estimated from a multistate (age and reproductive status) Integrated Population Model. Blue circles and whiskers represent aerial survey abundance estimates and their 95% confidence interval, respectively. The LRP and PRP, as well as carrying capacity (K) along with its 95% CrI (grey rectangle) are also presented for reference.

The new IPM formulation developed for BEL-EHB was also used to model the JAM stock abundance and trend. However, only abundance from surveys and annual harvest numbers were used as sources of observational data to inform the model. Based on the IPM, the JAM stock increased over the time series until 2014, and has since stabilized. The JAM stock abundance in 2024 was estimated at 16,000 (95% CrI = [12,100; 30,300]) beluga. Between 2021 and 2024, the average number of JAM beluga harvested per year was estimated at 31, with the 2024 estimate being 24 beluga. The contribution of harvest to overall mortality for the JAM stock was low and ranged between 1.6% (95% CrI = [0.2, 7.2]) in 2008 and 12.4% (95% CrI = [1.6, 39.9]) in 2021.

## Harvest advice

The current management plan (2021-2026) objective for BEL-EHB beluga is to ensure a 50% or greater probability that the BEL-EHB beluga stock will remain at 3,400 beluga (i.e., the 2016 abundance estimate at which point the stock was considered stable; Hammill et al. 2017; DFO 2020). However, this 3,400 abundance estimate is no longer aligned with recent understandings of the BEL-EHB stock dynamics; based on the new population model, in retrospective, the 2016 abundance can be re-evaluated at 3,000 (95% CrI: [2,700; 3,300]). The current assessment



suggests that the stock has been below 3,400 individuals (with a 95% probability) every year since 2015, and that no harvest level of BEL-EHB beluga would allow the stock to reach or surpass 3,400 animals in the next five to ten years. The maximum number of BEL-EHB beluga that could be harvested annually to ensure a 50%, 80% and 95% probability that the stock remains stable to its 2024 abundance are 50 (Figure 3), 43 and 35 BEL-EHB beluga, respectively.

Projecting the population forward in time for three generations (86 years) under the current BEL-EHB harvest level (i.e., average annual harvest for 2021-2024; 140 beluga) suggests that quasi-extinction (i.e., reaching less than 50 adult females) could be attained by 2037 (50% probability) to 2039 (95% probability) (Figure 4). Reducing annual harvest to 75% and 50% of current harvest levels postpones quasi-extinction to 2044 and 2072, respectively. With a reduction to 25% and 10% of the current harvest level, the population is projected to increase and reach 5,400 (95% CrI = [2,700; 7,200]) and 7,300 [95% CrI = [6,200; 8,600]) beluga in 86 years, respectively.

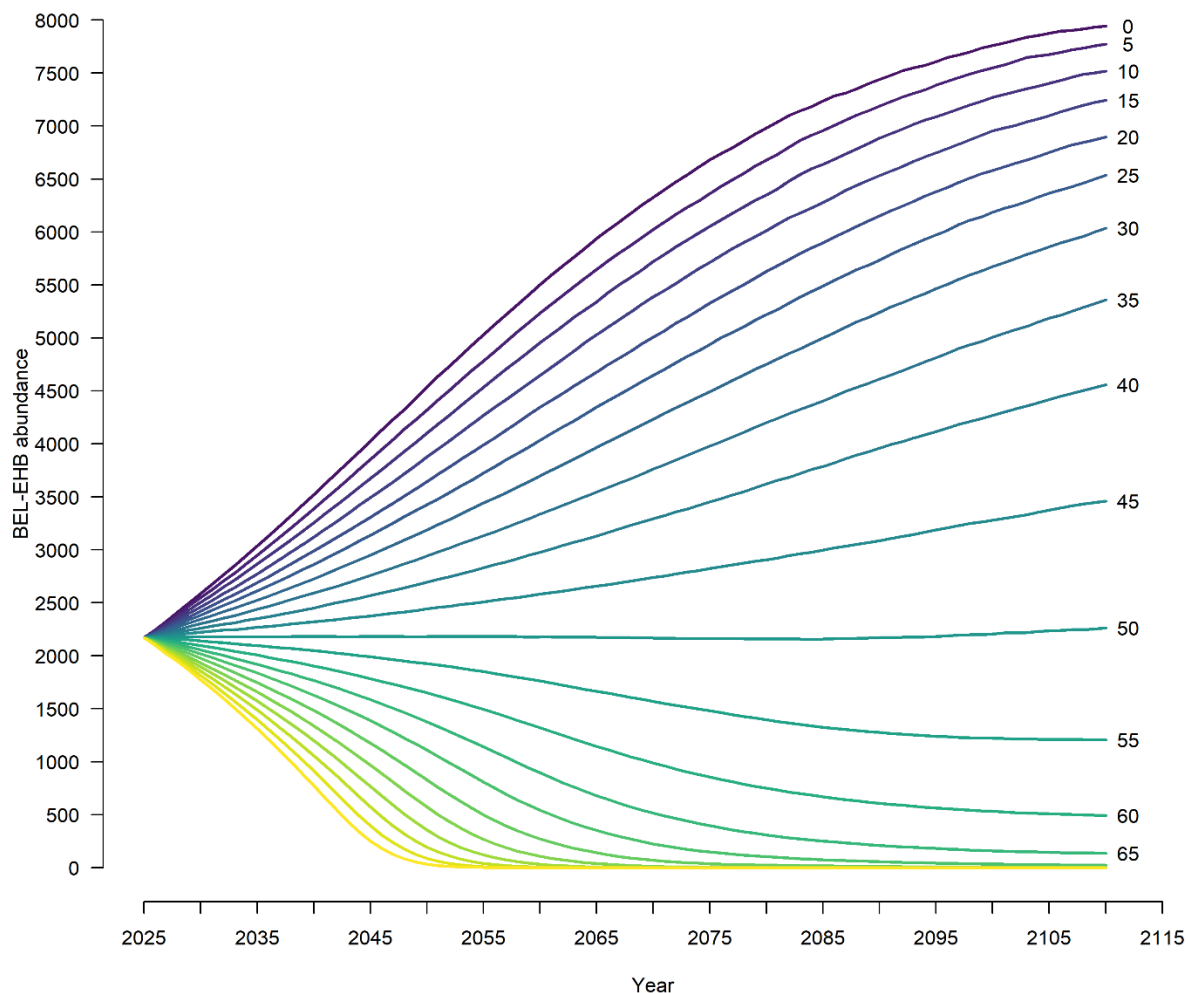


Figure 3. Median projected demographic trend (over three generations) for the BEL-EHB stock considering scenarios of future harvest levels ranging from 0 to 100 BEL-EHB beluga per year.

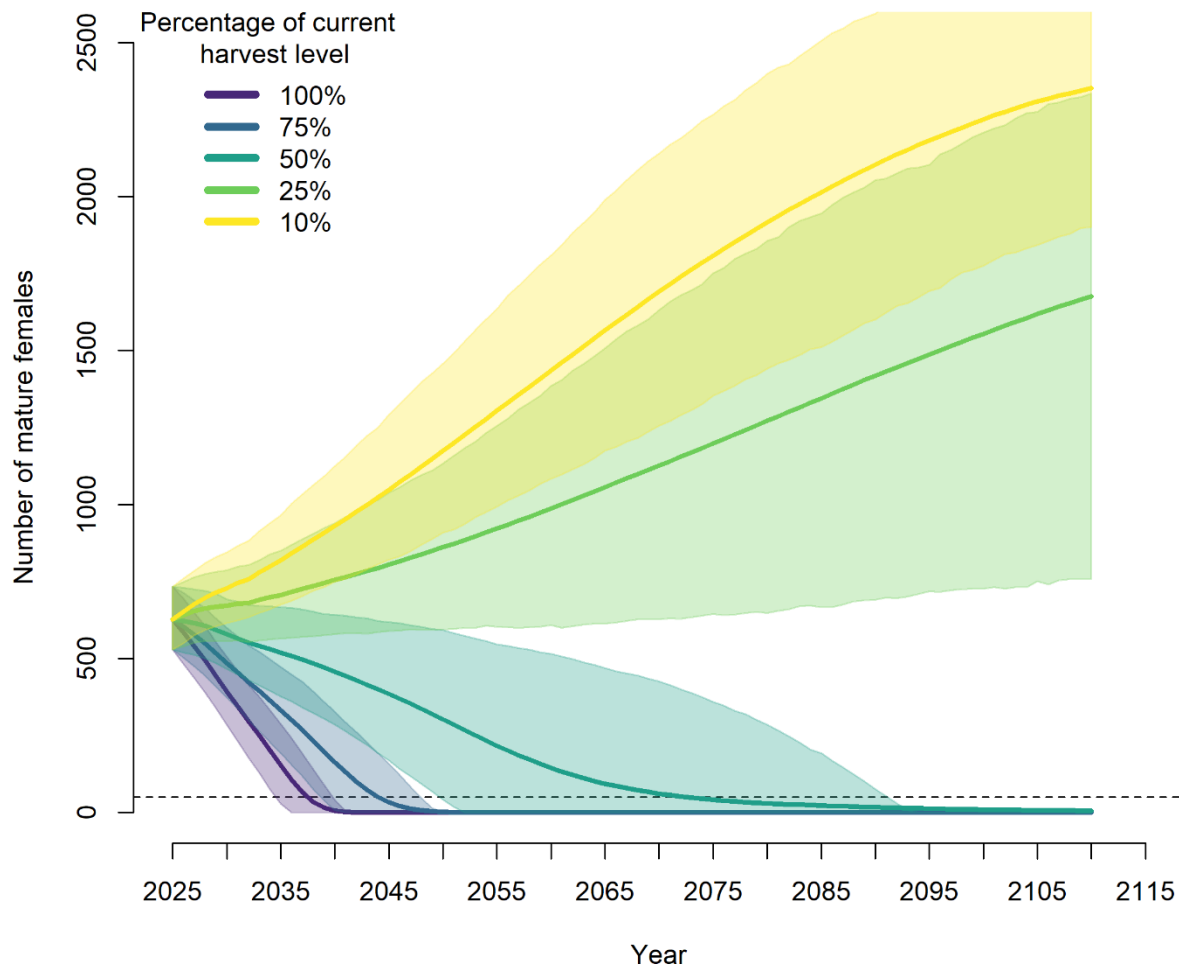


Figure 4. Projection of the number of mature females in the BEL-EHB beluga stock over three generations (86 years) under various harvest levels. The current harvest level is estimated at 140 BEL-EHB beluga per year, which represents the average over the 2021-2024 period. Correspondingly, the 75%, 50%, 25% and 10% percents of the current level represent 105, 70, 35 and 14 BEL-EHB beluga harvested annually, respectively. The dashed line represents 50 mature females, which is the quasi-extinction threshold.

Under the DFO-MSY framework, the Limit Reference Point (LRP) for the BEL-EHB beluga stock is estimated at 1,900 beluga and the Precautionary Reference Point (PRP) at 3,900 beluga. Considering the 2024 model estimate, the BEL-EHB stock is considered in the Cautious Zone, with a 89% probability of being above the LRP and 100% probability of being below PRP. The annual harvest levels ensuring that the stock will remain above the LRL or reach or surpass the PRL with different probabilities over various time frames are presented in Table 3.

Table 3. Annual harvest levels compatible with management objectives for the BEL-EHB beluga stock. A dash indicates that the specified management objective is unachievable under zero-harvest conditions.

Management objective	Projection interval	50% probability	80% probability	95% probability
Remain above LRP	5 years	88	59	30
	10 years	66	50	36
	25 years	55	46	37
Reach or surpass PRP	5 years	-	-	-
	10 years	-	-	-
	25 years	13	3	-

Based on model estimates of  $N_{min}$  in 2024 (2,000 beluga) and  $R_{max}$  (4%), and using a FR of 0.1, the Potential Biological Removal (PBR) for the BEL-EHB stock is 4 beluga.

There is currently no management objective for the JAM stock. The PBR for the stock is 245 beluga per year, considering an  $N_{min}$  of 14,200 beluga, a  $R_{max}$  of 3%, and a Recovery Factor of 1.

### Sources of Uncertainty

Aerial survey estimates for beluga are naturally variable given the clumped distribution of the species. Much of this variability is associated with group size, and whether large groups are encountered or not, and how often. Factors affecting group size are poorly understood, but may be related to social behaviour, bathymetry, local foraging conditions, and population size.

Depth at which beluga can be detected varies with water turbidity. Currently, a mean correction for availability bias is applied in all sectors given that information on water turbidity is lacking for James Bay and the Belcher Islands-eastern Hudson Bay area.

Our understanding of beluga stock structure in the Hudson Bay-Strait complex has greatly improved over the past two decades. Additional sampling (through harvest or non-lethal methods) would further improve the genetic characterization of beluga summering along the Ontario coast of Hudson Bay, in northwest James Bay, southern Ungava Bay (Marralik-Ungunniavik rivers), and from eastern Hudson Bay.

The genetic approach for estimating the contribution of each stock to the harvest currently does not assign each harvested beluga to a specific stock. Consequently, information on age and sex structure, and on annual reproductive rates in the IPM are not specific to BEL-EHB beluga.

Harvest levels, including struck and lost rates, have a considerable impact on the demographic trend and abundance estimates derived from the IPM. Currently, struck and lost rates from other stocks are used to inform the IMP given the absence of data for Nunavik and Sanikiluaq. This rate is also assumed to remain constant over time despite suspected (but undocumented) regional and temporal variations in hunting practices and reporting.

Genetics support including Long Island in the James Bay stratum (beluga harvested there belong to the JAM stock). However, there is uncertainty as to whether a clear spatial separation exists between the JAM and BEL-EHB stock distributions. Possible movements of beluga between strata cannot be excluded, although setting the limit between the two strata in a low beluga density area likely limit this potential bias.

The survey area for BEL-EHB is informed by multiple data sources and is thought to encompass the full summer distribution of this stock. Telemetry work is needed to better understand movement patterns and the range of the BEL population.

The IPM estimates carrying capacity and reference points under the DFO-MSY framework using the entire time series. A shift in environmental conditions could affect reference points and projections of population abundance.

## **CONCLUSIONS AND ADVICE**

The current assessment has improved the accuracy of abundance estimates and our understanding of the status of the BEL-EHB and JAM beluga stocks. The integration of abundance estimates into a comprehensive population model, along with 30 to 40 years of data from multiple sources, has highlighted several processes underlying BEL-EHB and JAM beluga stock trends.

The BEL-EHB stock has been declining since approximately 2013. The rate of decline has accelerated to 5.1% since 2021, resulting in a current abundance estimate of approximately 2,200 animals. Under the DFO-MSY PA framework, the stock is estimated to be in the Cautious Zone. Harvest has been an important source of mortality for this stock over the past five decades, and its contribution to overall mortality has increased to reach 63% in 2024. From 2021 to 2024, the average harvest level for the BEL-EHB stock has been 140 beluga per year. If this current harvest level is maintained, the stock is predicted to reach a state of quasi-extinction (50 mature females) by 2037. Harvest levels not exceeding 35 to 50 BEL-EHB belugas are expected to prevent further decline of the stock, depending on risk tolerance (i.e., 95% to 50% probabilities of stability). Annual harvest levels not exceeding 37 BEL-EHB beluga would allow the stock to remain above the LRP for 25 years with high certainty (95% probability).

The JAM stock increased over the time series until 2014. Since then, the JAM stock has levelled off close to carrying capacity to an estimated 16,000 individuals in 2024.

## **OTHER CONSIDERATIONS**

Based on the DFO-MSY framework, the JAM beluga stock currently lies in the Healthy Zone, i.e., above PRP, while the BEL-EHB beluga stock lies in the Cautious Zone, but is declining and approaching the LRP and the Critical Zone. Under the Precautionary Approach, if a stock falls below the LRP, it is considered to have suffered serious harm, and there is an obligation to implement a rebuilding plan for the stock. For a declining stock approaching the LRP, the requirement is to (1) implement management measures to promote stock growth and cease preventable declines and, (2) initiate the development of a rebuilding plan in advance of the stock declining to its LRP.

The current management approach does not allow for rebuilding of the BEL-EHB stock and does not account for potential unusual mortality events. Moreover, the model projections in this assessment do not account for possible changes in environmental conditions, nor for a potential Allee effect (i.e., decrease in population growth at very small population sizes; Allee and Bowen 1932). For small populations, Allee effects may increase the risk of extinction and prevent

recovery despite relief from anthropogenic threats (Dennis 1989; Liermann and Hilborn 2001). This assessment estimates that should current harvest levels be maintained, the BEL-EHB beluga stock may reach a state of quasi-extinction within the next 15 years. This timeframe may be an overestimate as it doesn't account for unusual mortality events, adverse environmental conditions and/or an Allee effect interfering with the stock's population dynamics.

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