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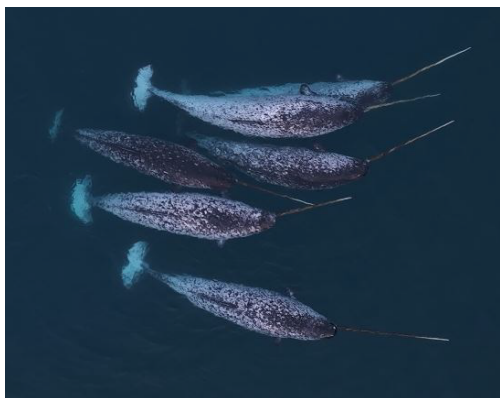
Ecosystems and
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Sciences des écosystèmes
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Canadian Science Advisory Secretariat
Science Advisory Report 2026/043

Arctic Region

2025 STOCK ASSESSMENT AND A LIMIT REFERENCE POINT FOR NORTHERN HUDSON BAY NARWHAL



Narwhal (*Monodon monoceros*)

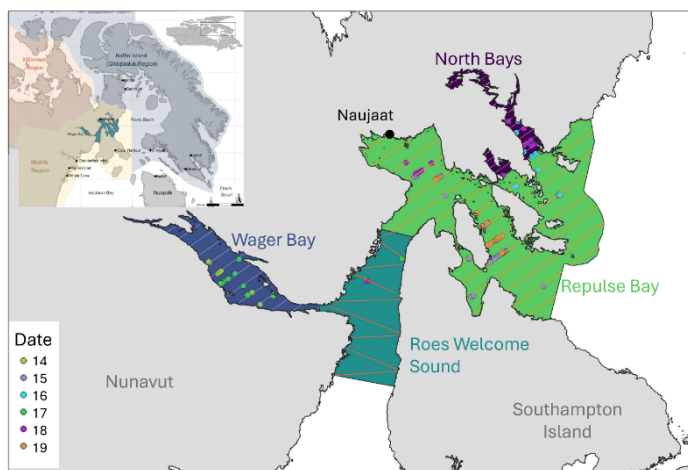


Figure 1. Map indicating narwhal detections (points) on transect lines in four strata surveyed in the 2024 Northern Hudson Bay narwhal survey. Different colored points indicate different days in August the detections were made.

CONTEXT

Inuit subsistence harvests of Northern Hudson Bay (NHB) narwhal occur mainly in the Kivalliq Region of Nunavut, with smaller subsistence harvests in the Qikiqtaaluk and Nunavik regions. Subsistence harvests of NHB narwhal are currently managed by considering Total Allowable Landed Catch (TALC) advice from Fisheries and Oceans Canada (DFO) Science, developed from aerial surveys of the NHB narwhal summer range.

DFO visual aerial surveys conducted in 2018 produced a corrected population abundance estimate of 19,200 (95% CI = 11,300–32,900) NHB narwhal (DFO 2020). The 2018 abundance estimate provided a sufficient time series of survey-based estimates to evaluate the use of a population model to estimate current abundance and determine trends in NHB population dynamics; however, a longer time series of aerial survey estimates was recommended (DFO 2022). An aerial survey was completed in August 2024, which will add to this series of abundance estimates for NHB narwhal. DFO Science was requested to review this survey to provide an updated abundance estimate. In addition, DFO's Sustainable Fisheries Framework (SFF) requires the development of a Limit Reference Point (LRP) for key regional fisheries and DFO Science is requested to develop an LRP for the Northern Hudson Bay (NHB) narwhal population.

Fisheries Management requested DFO Science to 1) provide an updated estimate of abundance for the Northern Hudson Bay narwhal population based on the 2024 survey, 2)

Provide advice on sustainable narwhal harvests using the Potential Biological Removal method and the probability that narwhal abundance will decline in 10 years under a range of harvest scenarios, and 3) provide recommendations and conclusions related to the development of a Limit Reference Point for the sustainable management of the Northern Hudson Bay narwhal population.

This Science Advisory Report is from the regional peer review March 17-20, 2026, on Limit Reference Points (LRP) for Northern Hudson Bay Narwhal population. Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

SUMMARY

- Photographic aerial surveys conducted in August 2024 provided an adjusted estimate of 5,800 Northern Hudson Bay (NHB) narwhal (95% CI 4,000-8,500 [all estimates are rounded to the nearest hundred]).
- A population model integrating four survey estimates from 1982-2024 and a series of reported annual harvests from 1951-2024 was fit to estimate 2025 abundance and determine trends in population dynamics of NHB narwhal.
- The model estimated a 2025 abundance of 10,400 narwhal (95% CI 7,700-13,800). Sustainable harvest advice is based on this modelled abundance.
- Based on the model trajectories, a harvest of 0, 57, 74, 83, 91, 107, and 250 narwhal per year would result in a 0%, 20%, 40%, 50%, 60%, 80%, and 100% probability of decline, respectively, in the NHB narwhal population in ten years.
- Potential Biological Removal (PBR) from the modelled 2025 abundance estimate was 183, resulting in a landed catch of 147 to account for whales struck and lost.
- The modelled carrying capacity ($K = 12,800$ (95% CI 9,600-18,800)) was robust, which allowed us to calculate a reliable limit reference point based on 30% of K . This resulted in an estimated limit reference point of 3,800 (95% CI 2,900-5,600). The abundance estimate for the NHB narwhal population is above the limit reference point.
- The NHB population appears to be approaching K , and K can be used to inform sustainable harvest levels. In populations approaching K , PBR may allow for a decline in abundance.
- Sustainable harvest levels can be informed using population modelling with the risk-based approach or PBR, depending on management objectives.

INTRODUCTION

An aerial survey of Northern Hudson Bay (NHB) narwhal was conducted in August 2024. With the addition of the 2024 abundance estimate and updated harvest statistics, a population model with aerial survey (1982-2024) and reported harvest data (1951-2024) was assessed. Here we present the results from the 2024 aerial survey and an updated population model with resulting sustainable harvest recommendations.

ASSESSMENT

2024 Survey

Photographic aerial surveys were conducted from 13-19 August 2024 (Figure 1). Two full replicates of the survey were completed. Survey abundance estimates were adjusted for diving animals that are not visible at the surface, known as availability bias. Availability bias was estimated using data from nine narwhals equipped with satellite-linked time-depth recorders (STDR) near the community of Naujaat in 2006 and 2007. The proportion of time narwhals spent within 2 m of the surface in the month of August with a CV that factored in the uncertainty in the 2 m cutoff, resulted in an instantaneous availability bias of 3.16 (CV 0.20).

A variance-weighted average abundance of the two surveys resulted in an estimated abundance of 5,800 (95% CI 4,000-8,500) narwhal, and this was used in the population model (Table 1).

Table 1. Total population abundance estimates from photographic surveys flown 13-19 August 2024. The average of the survey replicates was weighted by the variance.

Survey	Strata	Date Flown	Estimate	CV (%)	95% CI
1	Roes Welcome	13 Aug	0	-	-
	Wager Bay	14 Aug	573	-	-
	North Bay	16 Aug	831	-	-
	Repulse Bay	15-16 Aug	3,990	-	-
	Total		5,394	31.50	-
2	Roes Welcome	17-18 Aug	577	-	-
	Wager Bay	16 Aug	1,506	-	-
	North Bay	18 Aug	549	-	-
	Repulse Bay	18-19 Aug	3,587	-	-
	Total		6,220	24.82	-
Weighted Average			5,847	19.54	4,001-8,545

Population Model

The population model fit to the aerial surveys and reported annual harvests estimated a 2024 population of 10,300 narwhal (95% CI 7,600-13,700 [rounded to the nearest hundred]), a 2025 population of 10,400 (95% CI 7,700-13,800), and a carrying capacity of 12,800 (95% CI 9,600-18,800) (Figure 2). The modelled estimate of abundance and the carrying capacity were consistent among a range of model runs using different input parameters. Under recent landed catches, the model estimated that the population has been stable. The model also suggested the NHB narwhal population is close to carrying capacity and therefore density dependent effects may slow population growth.

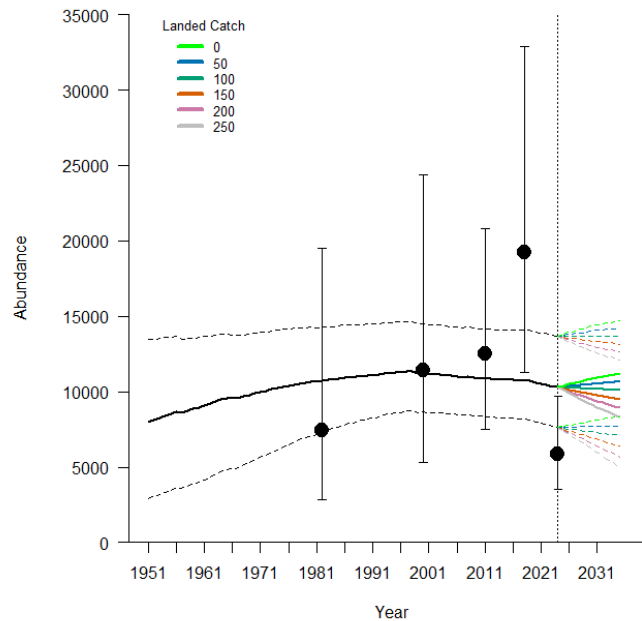


Figure 2. Estimated NHB narwhal population trajectory after fitting the population model to abundance estimates from five aerial surveys flown between 1982–2024. The solid line indicates the median estimate and dotted lines represent the 95% Credibility Intervals. Coloured lines beyond 2024 are projected trajectories at annual landed catches of 0, 50, 100, 150, 200, and 250.

The model predicted probabilities of decline associated with a given annual landed catch for the NHB narwhal population in ten years (Table 2), assuming animals are taken in proportion to the population sex and age structure. The average annual reported catch over the past ten years was 112 and harvest takes of 112 per year are estimated to result in a 87% probability of decline in the NHB narwhal population in ten years.

Table 2. Percent probability (*P*) of population decline in 10 yrs under different annual landed catches.

P (%)	Landed Catch
0	0
5	21
10	43
20	57
30	66
40	74
50	83
60	91
70	100
80	107
90	116
95	124
100	250

Potential Biological Removal (PBR)

We are confident that the model provides a more robust estimate of the current population size than a point estimate from a single survey; therefore, we calculated PBR based on the modelled 2025 estimate of abundance rather than using the 2024 aerial survey estimate.

Based on the 2025 model estimate of N_{Min} (9,158), using a recovery factor of 1 following guidelines for a population >70% of its carrying capacity (DFO 2025), and the default maximum growth rate (4% per year), PBR was 183 narwhal. The corresponding landed catch was 147 narwhal, using the model estimate for struck and lost and non-reporting rate of 25.0%.

Limit Reference Point

The Limit Reference Point was calculated as 30% of the modelled estimate for carrying capacity (K) (DFO 2025), which resulted in a LRP of 3,800 (95% CI 2,900-5,600).

Sources of Uncertainty

The survey area for NHB narwhal is informed by multiple data sources and is thought to encompass the full summer distribution of this stock but does not discount the possibility that whales were distributed outside of the surveyed region. Future work is needed to better understand movement patterns and the range of the NHB narwhal population.

Killer whales are also becoming regular occurrences and were sighted by community members from Naujaat before the survey period in 2024. Killer whale impacts on the distribution, abundance, and behaviour of narwhal are unknown.

The availability bias adjustment factor used to adjust the survey estimates for animals that are not visible at the surface is the best value currently available for NHB; however, they are derived from only nine whales tagged in NHB in 2006–2007 and three whales tagged from the Baffin Bay population in 1999–2000. Additional research on narwhal behaviour that coincides with the timing of the survey would improve the availability bias adjustment factor.

The population dynamics model assumes animals are taken in proportion to the population's sex and age structure. There is information to suggest that the hunt may be biased to adult males, but more information on the harvested animals would help to test this assertion.

Detailed information on narwhal struck and loss rates would improve model estimates. Currently this rate is assumed to remain constant over the modelled time series but these rates may vary annually and seasonally.

This narwhal population has one of the most southern distributions and there have been significant changes in environmental conditions in this area. The impacts of these changes and anthropogenic disturbance on the future distribution and abundance of the NHB narwhal population are unknown.

CONCLUSIONS AND ADVICE

The addition of the 2024 abundance estimate and long-term harvest information makes it possible to provide advice on landed catch using a population model. The population model estimated a stock abundance of 10,400 (95% CI 7,700-13,800) narwhal in 2025. The model predicted that a landed catch of 0, 57, 74, 83, 91, 107, and 250 narwhal per year would result in a 0%, 20%, 40%, 50%, 60%, 80%, and 100% probability of decline, respectively, in the NHB narwhal population in ten years. A PBR of 183 and corresponding landed catch of 147 were calculated from the modelled abundance for 2025. The NHB population appears to be

approaching carrying capacity, and therefore PBR may allow for a decline if the population is nearing its maximum productivity level. Sustainable harvest levels can be informed using population modelling with the risk-based approach or PBR depending on management objectives.

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SOURCES OF INFORMATION

DFO. 2025. Revised Atlantic Seal Management Strategy. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2025/005.

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