



## THREAT ASSESSMENT FOR NORTHERN BOTTLENOSE WHALES OFF EASTERN CANADA



Northern Bottlenose Whale (photo credit: Whitehead Lab, Dalhousie University).

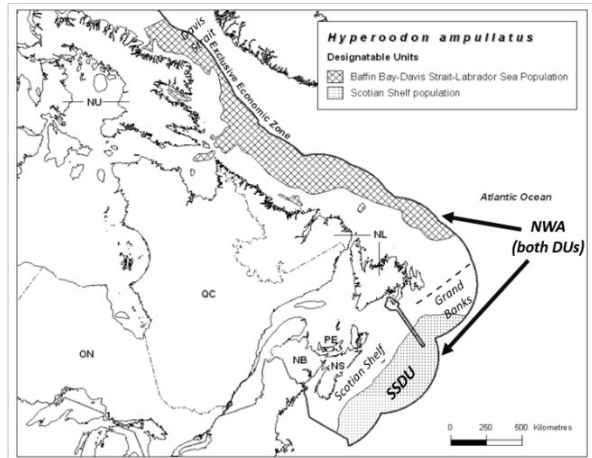


Figure 1. Boundaries of the two Northern Bottlenose Whale (NBW) Designatable Units (DUs) in eastern Canadian waters; the broken line represents an arbitrary boundary between the DUs. This threat assessment considered two geographic scales: the Scotian Shelf population DU (SSDU), and the range of NBW throughout the Northwest Atlantic (NWA) which includes the DUs of both populations. Modified from COSEWIC (2011), with the Department of the Environment's permission.

### Context:

There are two populations of Northern Bottlenose Whales (NBW) recognized in Canada, which are managed separately: the Scotian Shelf population (listed as Endangered under the Species at Risk Act; SARA) and the Davis Strait-Baffin Bay-Labrador Sea population (not currently listed under the SARA). A Recovery Potential Assessment (RPA), which informs the development of the SARA Recovery Strategy and Action Plan, was completed for the Scotian Shelf population of NBW in 2011. Threats were identified and discussed within the RPA and Recovery Strategy, but were not evaluated against a threat assessment framework. The description of threats included in these documents is now more than 10 years out of date.

The Fisheries and Oceans Canada (DFO) Species at Risk Program requested DFO Science conduct a threat assessment, following the 2014 DFO guidelines, for the Scotian Shelf NBW population, as well as for NBW in Canadian waters (including both the Scotian Shelf and Davis Strait-Baffin Bay-Labrador Sea populations) to provide a broader perspective on threats to this species.

This Science Advisory Report is from the February 22–26, 2021 National Marine Mammal Peer Review on the Threat assessment for northern bottlenose whales off eastern Canada. Additional publications

from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

## SUMMARY

- A threat assessment was conducted for 15 threat categories to Northern Bottlenose Whales (NBW) at two nested geographic scales: for the endangered Scotian Shelf population specifically (SSDU), and for both populations of NBW (SSDU and Davis Strait-Baffin Bay-Labrador Sea [DSBBLs] population) in the Northwest Atlantic (NWA). This included evaluating threats at both the individual and population level.
- The individual level of impact was assessed (for both the SSDU and NWA) as high or extreme for the threats of historical whaling, military sonar, entanglement, risks of depredation, vessel strike, and oil spills.
- The population level of impact for the SSDU was assessed as either high or extreme for climate change, historical whaling, military sonar, entanglement, vessel strikes, and oil spills.
- The population level of impact for the NWA was assessed as high for historical whaling, climate change was assessed as medium, and vessel noise was assessed as low, while the other 12 threats were assessed as unknown, primarily because there is no information on the size of the DSBBLs population of NBW.
- Categorization of a particular threat as unknown at the individual or population level of impact does not indicate a lack of effect or that the threat is not important. In many cases impacts are known to occur on individuals even if population level impacts have not been or cannot easily be measured. It is likely that mortalities, injuries, and other impacts are underreported due to the offshore habitat of NBW.
- This threat assessment does not take into account impacts on habitat, indirect effects, interactions between multiple threats, or cumulative effects. The impacts of multiple threats combined may result in higher overall threat risk for NBW than any individual threat on its own. Climate change is a particularly concerning threat which may alter the level of risk of other threats to NBW.

## BACKGROUND

There are two populations of Northern Bottlenose Whales (NBW, *Hyperoodon ampullatus*) recognized in Canada that are managed separately: the Scotian Shelf population listed as Endangered under the Canadian Species at Risk Act (SARA) and the Baffin Bay-Davis Strait-Labrador Sea population assessed as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and under consideration for listing under the SARA. The Scotian Shelf population is a small population of approximately 175 individuals generally occupying deep waters (> 500 m) along the Scotian Shelf off Nova Scotia and the Grand Banks off southern Newfoundland (Figure 1). Critical habitat for this population was identified in a recovery strategy as areas in the Gully, Shortland Canyon, and Haldimand Canyon of the eastern Scotian Slope, which are protected under the SARA. The inter-canyon areas have also been identified as important foraging habitat and movement corridors. The estimated Potential Biological Removal (PBR) for this small population is 0.3 individuals/year, thus human-caused mortality of even a single individual each year represents a population-level impact. The distribution of the Davis Strait-Baffin Bay-Labrador Sea population extends from the Arctic to waters off eastern Newfoundland (Figure 1), with a concentration of sightings in the

Davis Strait. The abundance and PBR for this population are unknown. Though COSEWIC delineates these two Canadian populations, the spatial boundary is not well understood. A Recovery Potential Assessment (RPA) was completed for Scotian Shelf NBW in 2011, but did not evaluate threats within a threat assessment framework as is now required.

## ASSESSMENT

### Approach

Threats to NBW were assessed to the extent possible using available information. The assessment was based on guidance provided in the 2014 DFO guidelines, with some modifications. Each identified threat for which there was at least some information available to support the conclusion that the threat has, is, or will likely impact the population to some degree was assessed at two nested geographic scales: for the Scotian Shelf population Designatable Unit (SSDU), as well as more broadly for NBW in Canada (i.e., for both populations) throughout the Northwest Atlantic (NWA). It should be noted that the SSDU reflects the SARA-listed population; however, the NWA was created for the purpose of this threat assessment and is not a grouping that is recognized under the SARA or to which the SARA applies. For each threat, the following criteria were assessed: likelihood of occurrence, individual level of impact, population level of impact, threat risk, timing of occurrence, threat frequency, and geographic extent of threat (Table 1). Data Quality (DQ) ratings were provided for each level of impact criteria (Table 1). Note that the individual level of impact assessments sometimes relied on information from outside of Canadian waters. The precautionary approach was applied when assessing threats for which limited or inconclusive information was available or in cases of uncertainty; in these situations, more precautionary higher-level rank categories were selected. In cases where a threat could result in several different impacts of varying severity, the most severe impact was assessed.

*Table 1. Description of threat criteria assessed and associated rank category definitions, as well as the Data Quality (DQ) rating definitions for individual and population level of impact.*

Criteria	Rank category definitions
<b>Likelihood of occurrence</b>	<p><b>Known:</b> there is a 91–100% chance that the threat has, is, or will be occurring</p> <p><b>Likely:</b> there is 51–90% chance that this threat is or will be occurring</p> <p><b>Unlikely:</b> there is 11–50% chance that this threat is or will be occurring</p> <p><b>Remote:</b> there is 1–10% or less chance that this threat is or will be occurring</p> <p><b>Unknown:</b> there are no data or prior knowledge of this threat occurring now or in the future</p>
<b>Individual level of impact</b>	<p><b>Extreme:</b> threat is linked to mass mortalities</p> <p><b>High:</b> threat is linked to mortality of single individuals</p> <p><b>Medium:</b> threat is linked to injury or harm of individuals</p> <p><b>Low:</b> threat is linked to harassment, disturbance, increased stress or similar impacts to individuals</p> <p><b>Unknown:</b> effect on individuals is not known</p>
<b>DQ for individual level of impact</b>	<p><b>(1) Considerable data:</b> substantial data are available to support the assessment, which have been observed, modeled, or empirically measured for NBW and come from peer-reviewed sources</p>

Criteria	Rank category definitions
	<p><b>(2) Adequate data:</b> some data are available that have been observed, modeled, or empirically measured for NBW or other beaked whales and come from peer-reviewed sources</p> <p><b>(3) Limited data:</b> there is a higher degree of uncertainty with the available data, which may be based on other cetacean species or may come from non-peer-reviewed sources</p> <p><b>(4) Expert judgement:</b> the assessment is based on expert judgement including traditional and local knowledge or general knowledge of the species or related species and their relative role in the ecosystem</p> <p><b>(5) Insufficient data:</b> impacts are possible, but very few data exist, or little is known about the impacts of the activity on the species or other cetacean species, and there is no basis for forming an expert opinion or making an assessment</p>
<b>Population level of impact</b>	<p><b>Extreme:</b> threat would result in a severe population decline with the potential for extirpation</p> <p><b>High:</b> threat is highly likely to jeopardize the survival or recovery of the population</p> <p><b>Medium:</b> threat is likely to jeopardize the survival or recovery</p> <p><b>Low:</b> threat is unlikely to jeopardize the survival or recovery</p> <p><b>Unknown:</b> effect on the population is not known</p>
<b>DQ for population level of impact</b>	<p><b>(1) Considerable data:</b> substantial data are available to support the assessment, which have been observed, modeled, or empirically measured for NBW within the study area/population of interest and come from peer-reviewed sources</p> <p><b>(2) Adequate data:</b> some data are available that have been observed, modeled, or empirically measured for NBW or other beaked whales within the study area/population of interest and come from peer-reviewed sources</p> <p><b>(3) Limited data:</b> there is a higher degree of uncertainty with the data available, which may come from outside the study area, may be based on other cetacean species, or may come from non-peer-reviewed sources</p> <p><b>(4) Expert judgement:</b> the assessment is based on expert judgement including traditional and local knowledge, or general knowledge of the species, or related species and their relative role in the ecosystem</p> <p><b>(5) Insufficient data:</b> impacts are possible or known to occur, but very few data exist, little is known about the population or the impacts of the activity on the population, and there is no basis for forming an expert opinion or making an assessment</p>
<b>Timing of occurrence</b>	<p><b>Historical:</b> threat is known to have occurred in the past and negatively impacted the population</p> <p><b>Current:</b> threat is ongoing and is currently negatively impacting the population</p> <p><b>Anticipatory:</b> threat is anticipated to occur in the future and will negatively impact the population</p>
<b>Threat frequency</b>	<p><b>Single:</b> threat occurs once</p> <p><b>Recurrent:</b> threat occurs periodically or repeatedly (including intermittent and seasonal activities)</p> <p><b>Continuous:</b> threat occurs without interruption</p> <p><b>Not applicable:</b> none of the rank categories above are applicable</p>

Criteria	Rank category definitions
<b>Geographic extent of threat</b>	<b>Extensive:</b> very high proportion (71–100%) of the population’s habitat is likely affected by the threat
	<b>Broad:</b> high proportion (31–70%) of the population’s habitat is likely affected by the threat
	<b>Narrow:</b> moderate proportion (11–30%) of the population’s habitat is likely affected by the threat
	<b>Restricted:</b> low proportion (< 10%) of the population’s habitat is likely affected by the threat

## Results

A threat assessment was conducted for 15 threats under six broad categories (see Appendix–Threat Assessment Table). Note that this assessment may not capture all existing threats to NBW in Canadian waters and it is possible that additional threats may emerge in the future.

Of the threats assessed, almost all are known to occur in both the SSDU and broader NWA; all are historical, current, and anticipatory (with the exception of historical whaling); all are either recurrent or continuous; and many are occurring over broad or extensive geographic scales (four threats occur over narrow or restricted geographic scales, and geographic scale is unknown in two cases). Table 2 summarizes the results of the individual and population level of impact assessments. Primarily because there is no information on the size of the DSBBLs population of NBW, the population level of impact of 12 of the threats was unknown for the NWA (Table 2). Lack of evidence for a particular population level of impact should not be assumed to be lack of effect, as in many cases it can be demonstrated that there are impacts occurring on individuals. As well, there is almost no ability to observe and record the impacts of many of these threats due to the remote offshore habitat of this species, and it is highly likely that mortalities, injuries, and other impacts are underreported.

*Table 2. Summary of the level of impact assessments for each of the 15 threats assessed for NBW. At the individual level of impact the assessments are the same for both the Scotian Shelf population Designatable Unit (SSDU) and the broader Northwest Atlantic (NWA). The assessments may vary between the SSDU and NWA at the population level of impact. Dashed line “-” indicates no threats categorized at that rank category for a particular level of impact.*

Rank Category	Individual Level of Impact	Population Level of Impacts	
	SSDU & NWA	SSDU	NWA
<b>Unknown</b>	(2 threats) climate change, drilling operations	(8 threats) seismic airgun surveys, drilling operations, echosounders, chronic noise, risks of depredation, persistent organic pollutants, toxic metals, plastics	(12 threats) military sonar, seismic airgun surveys, drilling operations, echosounders, chronic noise, entanglement, risks of depredation <sup>1</sup> , vessel strike, persistent organic

<sup>1</sup> Depredation refers to the removal of fish (by a whale) from fishing gear.

Rank Category	Individual Level of Impact	Population Level of Impacts	
	SSDU & NWA	SSDU	NWA
			pollutants, toxic metals, plastics, oil spills
<b>Extreme</b>	(2 threats) historical whaling <sup>2</sup> , military sonar	(1 threat) historical whaling <sup>3</sup>	-
<b>High</b>	(4 threats) entanglement, risks of depredation, vessel strike, oil spills	(5 threats) climate change, military sonar, entanglement, vessel strike, oil spills	(1 threat) historical whaling <sup>3</sup>
<b>Medium</b>	(5 threats) seismic airgun surveys, chronic noise, persistent organic pollutants, toxic metals, plastics	-	(1 threat) climate change
<b>Low</b>	(2 threats) vessel noise, echosounders	(1 threat) vessel noise	(1 threat) vessel noise

### Sources of Uncertainty

The focus of this threat assessment was to evaluate distinct threats to NBW at the population level; however, there remain many gaps in our understanding of the longer-term population-level consequences of threats that impact individuals for cetaceans in general, and particularly for remote offshore species such as NBW which are especially challenging to observe and study. It can be difficult to measure and assess the health and fitness of cetaceans, and there is typically very limited information available on how the sublethal and/or indirect effects of a threat may affect longer-term survival and reproduction. Cetaceans are long-lived species and it may take many years, or even decades, before impacts of a currently occurring threat on the broader population can be observed. While a quantitative evaluation of threat risk at the population level would be ideal, such information is not often available for cetacean populations, even when it is evident that important impacts on individuals are occurring.

This threat assessment was limited by a general lack of data for NBW throughout their range in the western North Atlantic in general, and in Canadian waters specifically. Delineation of the DU boundaries for the two Canadian populations is not biologically informed due to a poor understanding of NBW distribution over the NWA area, and there are no estimates of population size or PBR for the Davis Strait-Baffin Bay-Labrador Sea NBW population.

Assessing the effects of each threat individually may not accurately represent impacts on a population; the cumulative impacts of multiple threats (including over both space and time) may result in a higher overall threat risk for NBW than any individual threat on its own. Additionally, the impacts of a threat may be broader than the spatial and/or temporal occurrence of the threat itself. As well, this threat assessment does not take into account impacts on habitat, indirect

<sup>2</sup> Historical whaling is not a current threat, but the impacts of whaling are ongoing.

effects, or interactions between multiple threats—how such effects may impact the results of this threat assessment are also uncertain.

## CONCLUSIONS AND ADVICE

Climate change, historical whaling, military sonar, entanglement, vessel strikes, and oil spills (in no particular order) were considered to pose a high or extreme level of risk to NBW off eastern Canada, including the Scotian Shelf population. The level of risk associated with other threats assessed is largely unknown, though this does not indicate a lack of effect or that these threats are not important.

In addition to increasing understanding of the DSBBL population size and structure, and the DU boundaries, future threat assessments would be improved through a better understanding of individual and population-level impacts of threats for beaked whales (including climate change), and finer-scale quantitative assessments of the spatiotemporal overlap between the occurrence of NBW and threats.

It is important to note that the impacts of all threats combined likely result in a higher overall threat risk for NBW than any individual threat on its own. Climate change is a particularly important threat that may affect and change the level of risk of various other threats to NBW, especially the SSDU, being a small population occurring at the southern part of the species' range. Designing studies and monitoring efforts to increase understanding of how climate change is or will potentially impact NBW and assessing other threats to this species within the context of climate change are important steps towards developing an adaptive and flexible management plan to account for a rapidly changing environment.

## OTHER CONSIDERATIONS

The threat assessment guidance outlined in the 2014 DFO guidelines was challenging to use for assessing threats to NBW, and would likely be difficult to apply to any cetacean. It would be beneficial for this guidance to be revised based on the following objectives:

- Improve clarity and consistency of definitions within the guidance document
- Better meet the needs for data-poor species for which quantitative assessments are not possible and/or for which we are still learning the population-level effects of many threats
- Explicit consideration for the impacts of threats on individuals, habitat, and potential uncertainty in pathways for population-level response
- Incorporate guidance on how to account for indirect effects, interactions between threats, the cumulative effects of threats, and climate change.

A more thorough explanation within the guidance of how the threat assessment results will be used and what implications the different rank categories (e.g., unknown vs. other ranks) may have for the management of species would also be useful. Some modifications to the 2014 DFO guidance were incorporated within the approach used for this NBW threat assessment as an initial attempt to address some of these issues, but further work is required to more fully deal with the problems identified.

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## SOURCES OF INFORMATION

This Science Advisory Report is from the February 22–26, 2021 National Marine Mammal Peer Review on the Threat assessment for northern bottlenose whales off eastern Canada.

Additional publications from this meeting will be posted on the [Fisheries and Oceans Canada \(DFO\) Science Advisory Schedule](#) as they become available.

COSEWIC. 2011. [COSEWIC assessment and status report on the Northern Bottlenose Whale \*Hyperoodon ampullatus\* in Canada](#). Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 31 pp.

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## APPENDIX – THREAT ASSESSMENT TABLE

Summary of threat assessment for NBW in Canadian waters. This assessment considers both the Scotian Shelf NBW population within the boundaries of the Designatable Unit as defined by COSEWIC which includes deep waters off Nova Scotia and southern Newfoundland (geographic scale = SSDU); as well as NBW encompassing the broader range of both the Scotian Shelf and the Davis Strait-Baffin Bay-Labrador Sea populations in the Northwest Atlantic (geographic scale = NWA). Note that while the SSDU represents the SARA-listed population, the NWA is not a grouping that is recognized under the SARA or to which the SARA applies. Definitions for each of the threat evaluation criteria and the methods applied to assign values to each of these criteria are summarized in Table 1. DQ indicates the data quality rating associated with the chosen impact criteria. Timing of occurrence refers to Historical (H), Current (C), or Anticipatory (A). The individual level of impact was the same for both the SSDU and NWA, by definition.

Threat	Geographic Scale	Threat Evaluation Criteria						
		Likelihood of Occurrence	Individual Level of Impact (DQ)	Population Level of Impact (DQ)	Threat Risk	Timing of Occurrence (H, C, A)	Threat Frequency	Geographic Extent of Threat
<b>Threat 1: Climate Change</b>								
1: Climate Change	SSDU	Known	Unknown (5)	High (4)	High (4)	H, C, A	Continuous	Extensive
	NWA	Known		Medium (4)	Medium (4)	H, C, A	Continuous	Extensive
<b>Threat 2: Historical Whaling</b>								
2: Historical Whaling	SSDU	Known	Extreme (1)	Extreme (1)	High (1)	H <sup>3</sup>	Not applicable <sup>4</sup>	Extensive
	NWA	Known		High (2)	High (2)	H <sup>2</sup>	Not applicable <sup>3</sup>	Extensive
<b>Threat 3: Acoustic Disturbance</b>								
3a: Military sonar	SSDU	Known	Extreme (2)	High (3)	High (3)	H, C, A	Recurrent	Unknown
	NWA	Known		Unknown (5)	Unknown (5)	H, C, A	Recurrent	Unknown
3b: Vessel noise	SSDU	Known	Low (3)	Low (4)	Low (4)	H, C, A	Continuous	Extensive
	NWA	Known		Low (4)	Low (4)	H, C, A	Continuous	Broad

<sup>3</sup> Impacts of whaling are ongoing

<sup>4</sup> Whaling could become an issue if individuals were to be taken as part of sustenance hunts in Canada in the future (not currently an issue in Canada but does occur outside of Canada)

Threat	Geographic Scale	Threat Evaluation Criteria	Threat	Geographic Scale	Threat Evaluation Criteria	Threat	Geographic Scale	Threat Evaluation Criteria
3c: Seismic airgun surveys	SSDU	Known	Medium (3)	Unknown (5)	Unknown (5)	H, C, A	Recurrent	Extensive
	NWA	Known		Unknown (5)	Unknown (5)	H, C, A	Recurrent	Extensive
3d: Drilling operations	SSDU	Known	Unknown (5)	Unknown (5)	Unknown (5)	H, C, A	Recurrent	Restricted
	NWA	Known		Unknown (5)	Unknown (5)	H, C, A	Recurrent	Restricted
3e: Echosounders	SSDU	Known	Low (3)	Unknown (5)	Unknown (5)	H, C, A	Recurrent	Restricted
	NWA	Known		Unknown (5)	Unknown (5)	H, C, A	Recurrent	Restricted
3f: Chronic noise exposure	SSDU	Known	Medium (3)	Unknown (5)	Unknown (5)	H, C, A	Continuous	Extensive
	NWA	Known		Unknown (5)	Unknown (5)	H, C, A	Continuous	Extensive
<b>Threat 4: Fisheries Interactions</b>								
4a: Entanglement	SSDU	Known	High (1)	High (1)	High (1)	H, C, A	Continuous	Extensive
	NWA	Known		Unknown (5)	Unknown (5)	H, C, A	Continuous	Broad
4b: Risks of depredation	SSDU	Likely	High (3)	Unknown (5)	Unknown (5)	H, C, A	Recurrent	Unknown
	NWA	Known		Unknown (5)	Unknown (5)	H, C, A	Recurrent	Restricted
<b>Threat 5: Vessel Strikes</b>								
5: Vessel strike	SSDU	Known	High (1)	High (1)	High (1)	H, C, A	Continuous	Extensive
	NWA	Known		Unknown (5)	Unknown (5)	H, C, A	Continuous	Extensive
<b>Threat 6: Pollution and Chemical Contaminants</b>								
6a: POPs	SSDU	Known	Medium (2)	Unknown (5)	Unknown (5)	H, C, A	Continuous	Broad
	NWA	Known		Unknown (5)	Unknown (5)	H, C, A	Continuous	Broad
6b: Toxic metals	SSDU	Likely	Medium (3)	Unknown (5)	Unknown (5)	H, C, A	Continuous	Broad
	NWA	Likely		Unknown (5)	Unknown (5)	H, C, A	Continuous	Broad
6c: Plastics	SSDU	Known	Medium (2)	Unknown (5)	Unknown (5)	H, C, A	Continuous	Broad
	NWA	Known		Unknown (5)	Unknown (5)	H, C, A	Continuous	Broad
6d: Oil spills	SSDU	Known	High (3)	High (3)	High (3)	H, C, A	Recurrent	Narrow
	NWA	Known		Unknown (5)	Unknown (5)	H, C, A	Recurrent	Narrow

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