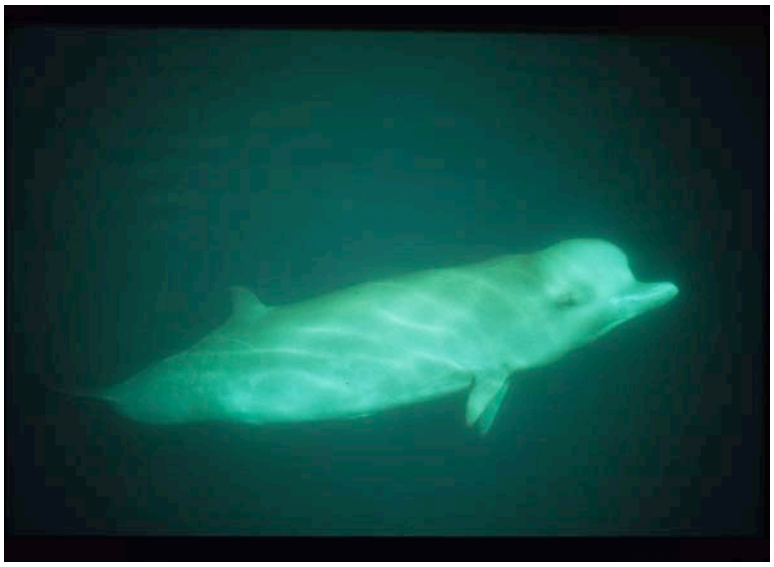
COSEWIC
Assessment and Status Report

on the

Northern Bottlenose Whale
Hyperoodon ampullatus

Davis Strait-Baffin Bay-Labrador Sea population
Scotian Shelf population

in Canada



Davis Strait-Baffin Bay-Labrador Sea population - SPECIAL CONCERN
Scotian Shelf population - ENDANGERED
2011

COSEWIC
Committee on the Status of Endangered Wildlife in Canada

COSEPAC
Comité sur la situation des espèces en péril au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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. (www.sararegistry.gc.ca/status/status_e.cfm).

Previous report(s):

COSEWIC 2002. COSEWIC assessment and update status report on the Northern Bottlenose Whale *Hyperoodon ampullatus* (Scotian shelf population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 22 pp.

Whitehead, H., A. Faucher, S. Gowans, and S. McCarrey. 1996. Update COSEWIC status report on the Northern Bottlenose Whale *Hyperoodon ampullatus* (Gully population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-22 pp.

Reeves, RR., and E. Mitchel. 1993. COSEWIC status report on the Northern Bottlenose Whale *Hyperoodon ampullatus,* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa. 16 pp.

Production note:
COSEWIC would like to acknowledge Hal Whitehead and Tonya Wimmer for writing the status report on the Northern Bottlenose Whale *Hyperoodon ampullatus*, in Canada, prepared under contract with Environment Canada. This report was overseen and edited by Randall Reeves, Co-chair of the COSEWIC Marine Mammals Specialist Subcommittee.

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: 819-953-3215
Fax: 819-994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur la baleine à bec commune (*Hyperoodon ampullatus*) au Canada.

Cover illustration/photo: © H. Whitehead lab.
Northern Bottlenose Whale — ©Hal Whitehead lab.

Catalogue No. CW69-14/77-2011E-PDF
ISBN 978-1-100-18675-7

Recycled paper

COSEWIC
Assessment Summary

Assessment Summary – May 2011

Common name
Northern Bottlenose Whale - Davis Strait-Baffin Bay-Labrador Sea population

Scientific name
Hyperoodon ampullatus

Status
Special Concern

Reason for designation
The population is of Special Concern for the following reasons: (1) numbers were likely reduced by whaling in the late 1960s and early 1970s when 818 whales were taken; (2) trends in population size since then are uncertain but survey sighting rates have been low; and (3) threats from fishery interactions are documented and ongoing. There is no abundance estimate. Entanglement in fishing gear is the primary known threat but noise and contaminants are also of concern. The whales in the Baffin Bay-Davis Strait-Labrador Sea region have been genetically linked to the population off Iceland so rescue is possible.

Occurrence
Atlantic Ocean

Status history
The Northern Bottlenose Whale was given a single designation of Not at Risk in April 1993. Split into two populations in April 1996 to allow a separate designation of the Northern Bottlenose Whale (Scotian Shelf population). The Davis Strait-Baffin Bay-Labrador Sea population was not assessed in 1996; it retained the Not at Risk designation of the original Northern Bottlenose Whale. The population was designated Special Concern in May 2011.

Assessment Summary – May 2011

Common name
Northern Bottlenose Whale - Scotian Shelf population

Scientific name
Hyperoodon ampullatus

Status
Endangered

Reason for designation
This well-studied population contains an estimated 164 individuals, of which approximately 93 are mature. The population appears to be stable but it is very small and at risk from entanglement in fishing gear and possibly also from anthropogenic noise produced by seismic surveys for oil and gas and from exposure to contaminants.

Occurrence
Atlantic Ocean

Status history
The Northern Bottlenose Whale was given a single designation of Not at Risk in April 1993. Split into two populations in April 1996 to allow a separate designation of the Northern Bottlenose Whale (Scotian Shelf population). Scotian Shelf population designated Special Concern in April 1996. Status re-examined and designated Endangered in November 2002 and in May 2011.

COSEWIC
Executive Summary

Northern Bottlenose Whale
Hyperoodon ampullatus

Davis Strait-Baffin Bay-Labrador Sea population
Scotian Shelf population

Wildlife species description and significance

The Northern Bottlenose Whale, *Hyperoodon ampullatus,* is a beaked whale found only in the northern North Atlantic. It is a sturdy, medium-sized (7-9m) whale, dolphin-like in appearance, with a beak and falcate dorsal fin, but much larger than most dolphins.

A substantial part of the total range of the Northern Bottlenose Whale lies in Canadian waters. The species is among the deepest and most prolonged divers of all mammals and is known for its tendency to approach vessels. The animals off the Scotian Shelf are the subjects of the most detailed research on any living species of beaked whale.

Distribution

Northern Bottlenose Whales are found in deep (>500m) waters of the northern North Atlantic, north of about 40^{o}N. There are five recognized areas of concentration, three in the eastern Atlantic, Iceland, Svalbard, and off mainland Norway, and two in Canadian waters, along the edge of the Scotian Shelf and off Labrador, including southern Baffin Bay.

The Baffin Bay-Davis Strait-Labrador Sea and Scotian Shelf populations are genetically distinct. The Scotian Shelf animals are generally smaller, may breed later in the year, and have higher pollutant loads than those in the Baffin Bay-Davis Strait-Labrador Sea population. Movement between the two populations seems to be very rare.

Habitat

Northern Bottlenose Whales occur primarily in continental slope waters 800-1,500m deep. The whales of the Scotian Shelf edge depend heavily on three locations, the large submarine canyons called the Gully, Shortland Canyon and Haldimand Canyon.

Biology

Males become sexually mature at 7-9 years old and females at 8-13, thereafter giving birth to single offspring about every two years. The life span is at least 37 years, and the generation time is about 15.5 years.

The Scotian Shelf population does not seem to migrate. Movements by whales of the Baffin Bay-Davis Strait-Labrador Sea population have not been studied.

While Northern Bottlenose Whales eat various deep-water fishes and squids, they are specialists compared with other deep-diving mammals, particularly favouring squids of the genus *Gonatus.*

Population sizes and trends

The Scotian Shelf population contains approximately 164 adult and immature animals, and has shown no statistically significant trend in population size between 1988 and 2009. There is no estimate of the size of the Baffin Bay-Davis Strait-Labrador Sea population.

In 1962-1967 whaling operations took 87 animals from the Scotian Shelf population, and in 1969-1971 whalers took 818 from the Baffin Bay-Davis Strait-Labrador Sea population.

Threats and limiting factors

Northern Bottlenose Whales in Canadian waters face two principal threats, entanglement in fishing gear and ocean noise. In both cases the threat is actual, but the extent of harm is uncertain. There are also concerns about contaminant levels in whale tissues, possibly related to oil and gas development activities.

Protection, status, and ranks

The Northern Bottlenose Whale is listed as a “Protected Species” by the International Whaling Commission with a catch limit of zero. The species is in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora and it is considered Data Deficient by IUCN. There is currently no regular hunt for Bottlenose Whales.

In Canada, hunting and other activities deliberately harmful to Northern Bottlenose Whales are covered by the Marine Mammal Regulations of the *Fisheries Act*. The Scotian Shelf population was listed as Endangered by COSEWIC in 2002 and was listed under Schedule 1 of SARA in April 2006. The Baffin Bay-Davis Strait-Labrador Sea population was implicitly considered “not at risk” when the species as a whole was assessed by COSEWIC in 1993.

The Gully was designated as a marine protected area in 2004 under the *Oceans Act*, with the core area of the protected area coinciding with the principal habitat of the Scotian Shelf Northern Bottlenose Whales. The remaining habitat of Northern Bottlenose Whales in Canada has no special protection.

TECHNICAL SUMMARY (Davis Strait-Baffin Bay-Labrador Sea population)

Hyperoodon ampullatus
Northern Bottlenose Whale
(Davis Strait-Baffin Bay-Labrador Sea population)

Baleine à bec commune
(Population du détroit de Davis, de la baie de Baffin et de la mer du Labrador)

Range of occurrence in Canada: Atlantic Ocean (off Newfoundland and Labrador, Nunavut)

Demographic Information

Generation time (see text)	15.5 years
Is there a continuing decline in number of mature individuals?	Unknown
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations	-
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over the last 10 years, or 3 generations	Unknown
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years, or 3 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over any 10 years, or 3 generations period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	-
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence (see text)	779,516 km²
Index of area of occupancy (IAO) (see text)	208,756 km²
Is the total population severely fragmented?	No
Number of "locations∗"	Unknown
Is there a continuing decline in extent of occurrence?	No
Is there a continuing decline in index of area of occupancy?	No
Is there a continuing decline in number of populations?	No
Is there a continuing decline in number of locations?	No
Is there a continuing decline in habitat?	No
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations∗?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals

Population	**N Mature Individuals**
Baffin Bay-Davis Strait-Labrador Sea population	Unknown
Total	Unknown

Quantitative Analysis

Probability of extinction in the wild is at least:	No estimate

∗ See definition of location.

Threats (actual or imminent, to populations or habitats)

Fishery interactions (some evidence of entanglement in fishing gear), anthropogenic underwater noise and contaminants are all actual threats at least to individuals; unclear if the scale of any of these threats is great enough to have population-level effects

Rescue Effect (immigration from outside Canada)

Status of outside populations? Unknown. A ship-survey estimate of several thousand animals off Iceland based on 86 sightings of the species (Gunnlaugsson and Sigurjónsson 1990) is uninformative because no corrections were made for the deep dives of the animals or for their attraction to vessels (Reeves *et al.* 1993). If the Bottlenose Whales seen off Newfoundland, and especially east of Newfoundland, belong to a different population (i.e. are not part of the Baffin Bay-Davis Strait-Labrador Sea population), they would represent rescue potential.	
Is immigration known or possible?	Unknown, possible from Greenland and Iceland populations.
Would immigrants be adapted to survive in Canada?	Probably
Is there sufficient habitat for immigrants in Canada?	Likely
Is rescue from outside populations likely?	Unknown

Current Status

COSEWIC: Special Concern (May 2011)

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Special Concern	Not applicable
Reasons for designation: The population is of Special Concern for the following reasons: (1) numbers were likely reduced by whaling in the late 1960s and early 1970s when 818 whales were taken; (2) trends in population size since then are uncertain but survey sighting rates have been low; and (3) threats from fishery interactions are documented and ongoing. There is no abundance estimate. Entanglement in fishing gear is the primary known threat but noise and contaminants are also of concern. The whales in the Baffin Bay-Davis Strait-Labrador Sea region have been genetically linked to the population off Iceland so rescue is possible.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable.
Criterion D (Very Small or Restricted Total Population): Not applicable.
Criterion E (Quantitative Analysis): None available.

TECHNICAL SUMMARY (Scotian Shelf population)

Hyperoodon ampullatus
Northern Bottlenose Whale — Baleine à bec commune
(Scotian Shelf population) — (Population du plateau néo-écossais)
Range of occurrence in Canada: Atlantic Ocean (off Nova Scotia, maybe Newfoundland and Labrador)

Demographic Information

Generation time (see text)	15.5 years
Is there a continuing decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations	-
Estimated percent increase in total number of mature individuals over the last 3 generations (extrapolating from 1988-2009 rate) [2%/year (95% confidence interval -1%/year to +6%/year) based on (natural) mark-resight analysis]	No statistically significant trend; three generations ago (1964) is during the major period of exploitation (1962-1967)
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years, or 3 generations.	Unknown
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over any 10 years, or 3 generations period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	-
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence (see text)	89,422 km²
Index of area of occupancy (IAO) (see text)	9,756 km²
Is the total population severely fragmented?	No
Number of "locations∗" (large canyons on Scotian Shelf which form primary habitat (Wimmer and Whitehead 2004))	At least 3
Is there a continuing decline in extent of occurrence?	No
Is there a continuing decline in index of area of occupancy?	No
Is there a continuing decline in number of populations?	No
Is there a continuing decline in number of locations?	No
Is there a continuing decline in habitat?	No
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations∗?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals

Population	**N Mature Individuals**
Scotian Shelf (see text)	93
Total	93

Quantitative Analysis

Probability of extinction in the wild is at least:	No estimate

∗ See definition of location.

Threats (actual or imminent, to populations or habitats)

Fishery interactions (some evidence of entanglement in fishing gear), anthropogenic underwater noise and contaminants are all actual threats at least to individuals; unclear if the scale of any of these threats is great enough to have population-level effects

Rescue Effect (immigration from outside Canada)

Status of outside populations? Unknown. A ship-survey estimate of several thousand animals off Iceland based on 86 sightings of the species (Gunnlaugsson and Sigurjónsson 1990) is uninformative because no corrections were made for the deep dives of the animals or for their attraction to vessels (Reeves *et al.* 1993). If the Bottlenose Whales seen off Newfoundland, and especially south of Newfoundland, belong to a different population (i.e. are not part of the Scotian Shelf population), they would represent rescue potential.	
Is immigration known or possible?	Unknown but unlikely. Genetic and other evidence for very few if any recent immigrants.
Would immigrants be adapted to survive in Canada?	Probably
Is there sufficient habitat for immigrants in Canada?	Unknown
Is rescue from outside populations likely?	Unlikely

Current Status

COSEWIC: Endangered (May 2011).

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Endangered	D1
Reasons for designation: This well-studied population contains an estimated 164 individuals, of which approximately 93 are mature. The population appears to be stable but it is very small and at risk from entanglement in fishing gear and possibly also from anthropogenic noise produced by seismic surveys for oil and gas and from exposure to contaminants.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable. Although the population was depleted by whaling in the 1960s, it has been stable or possibly growing slowly since the 1980s.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable as the extent of occurrence and index of area of occupancy exceed the thresholds.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable. Although the population is small, it is not declining.
Criterion D (Very Small or Restricted Total Population): Endangered under D1 as there are fewer than 250 mature individuals (93).
Criterion E (Quantitative Analysis): None available.

PREFACE

COSEWIC assessed the Northern Bottlenose Whale as an entire species in 1993 and assigned a status of Not at Risk. In April 1996, COSEWIC recognized the Scotian Shelf population (originally called “Gully population”) as a designatable unit which was assessed as Special Concern. The Scotian Shelf population was re-assessed in 2002 as Endangered. It was added to Schedule 1 of the *Species at Risk Act* (SARA) in 2006. The Baffin Bay-Davis Strait-Labrador Sea population (previously “Davis Strait population”) has not been assessed by COSEWIC since 1993 when it was considered (by inference) Not at Risk. This report considers both populations of the Northern Bottlenose Whale in Canada.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2011)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment Canada | Environnement Canada

Canadian Wildlife Service | Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Northern Bottlenose Whale
Hyperoodon ampullatus

Davis Strait-Baffin Bay-Labrador Sea population
Scotian Shelf population

in Canada

2011

TABLE OF CONTENTS

List of Figures

List of Tables

WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and classification

The Northern Bottlenose Whale, *Hyperoodon ampullatus* (Forster 1770), is a beaked whale, family Ziphiidae, found only in the northern North Atlantic. Its only congener, the Southern Bottlenose Whale, *Hyperoodon planifrons*, lives in the Southern Hemisphere. No subspecies are recognized. Variations on the English name include Northern Bottle-Nosed Whale (Mead 1989) and North Atlantic Bottlenose Whale (Rice 1998). The French name is baleine à bec commune.

Morphological description

The Northern Bottlenose Whale is a sturdy, medium-sized (7-9m) whale (Figure 1). It is dolphin-like in appearance, with a beak and falcate dorsal fin, but much larger than most dolphins. It has a pronounced forehead, bulbous in the case of females and immatures, and squared off, and often white, in the case of mature males. Mature males are also larger than females (by approximately 1m, Benjaminsen and Christensen 1979). Colour ranges from chocolate brown (possibly from diatom films; see Mead 1989) to light grey. Northern Bottlenose Whales have one pair of teeth, at the tip of the lower jaw, but these usually only erupt through the gums in older males.

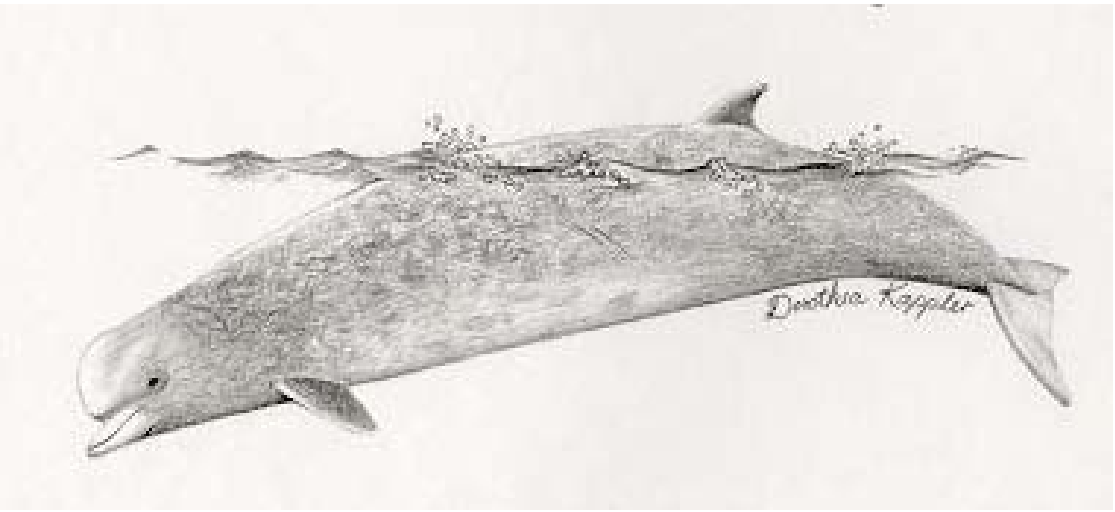


Figure 1. Northern Bottlenose Whale ©Parks Canada/Dorothea Kappler, 1995.

Population spatial structure and variability

Whaling for the Northern Bottlenose Whale was concentrated in six general areas across the northern North Atlantic (Figure 2): (i) Scotian Shelf, Canada; (ii) northern Labrador and southern Baffin Bay, Canada (hereafter called “Baffin Bay-Davis Strait-Labrador Sea population”); (iii) northern Iceland; (iv) Andenes, Norway; (v) Møre,

Norway; and (vi) Svalbard (Spitzbergen), Norway (Mead 1989). These areas of concentration all potentially represent distinct populations, although Bottlenose Whales are sometimes found in suitable habitat between them (Benjaminsen and Christensen 1979; see below).

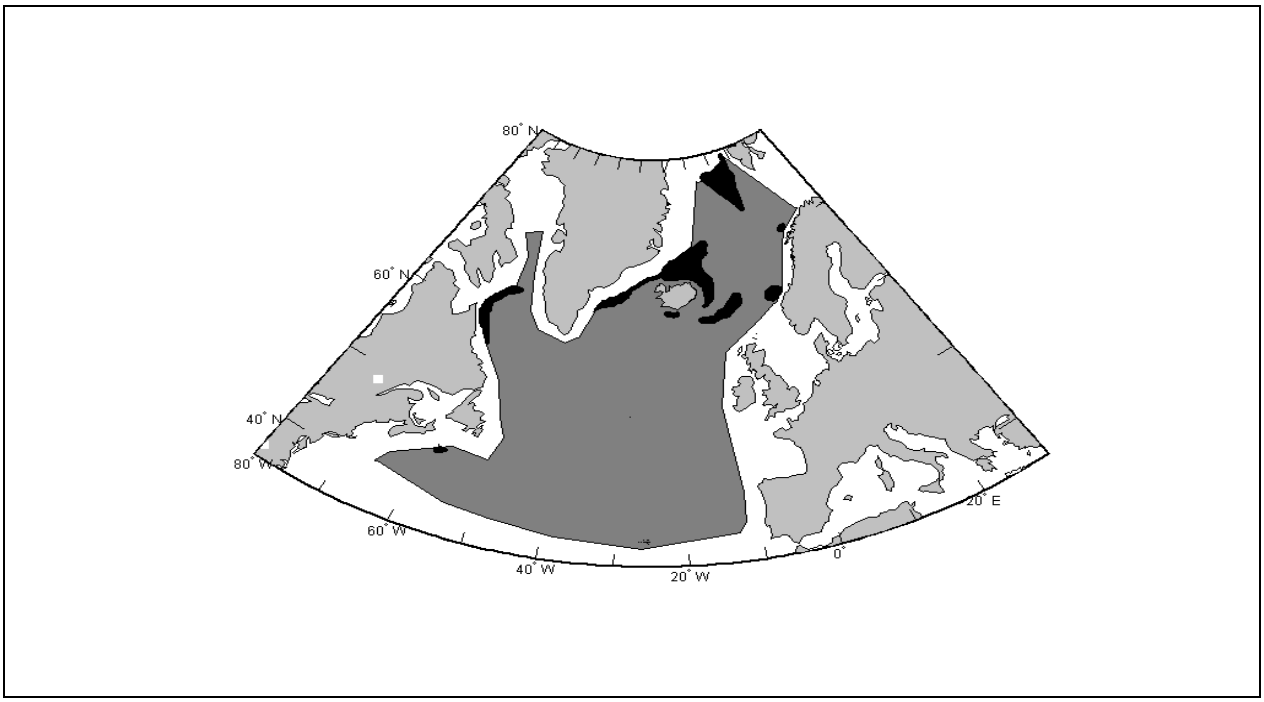


Figure 2. Approximate global distribution of Northern Bottlenose Whales (dark grey) with major areas of whaling for this species indicated in black.

Genetic analyses have addressed the distinctiveness of the two Canadian populations. Dalebout *et al.* (2006) used 10 microsatellites and 434bp of the mitochondrial DNA (mtDNA) control region sequence to compare animals from the Scotian Shelf (n=34, all from the Gully) and off Labrador (n=127, sampled between 60°N - 63°N). The differentiation of the Scotian Shelf and Baffin Bay-Davis Strait-Labrador Sea populations was confirmed by both microsatellites (FST= 0.0243, P< 0.0001) and mtDNA (ΦST= 0.0456, P< 0.05). Dalebout *et al.* (2006) estimated that fewer than two individuals per generation move between these areas. There was significant differentiation in both genomes for both males and females. For microsatellites, the differentiation (as indicated by FST) between the animals from the Scotian Shelf and the Baffin Bay-Davis Strait-Labrador Sea populations was similar for males and females.

There is additional evidence that the Scotian Shelf and Baffin Bay-Davis Strait-Labrador Sea populations are distinct.

The mean length of 451 photographically measured living animals (with some resampling of individuals) and 25 directly measured whaled animals from the Scotian Shelf was 0.7m shorter than the mean length of 127 animals taken by whalers off Labrador (Whitehead *et al.* 1997b). Such a size difference could reflect genetic variation (adaptive or neutral) or differences in nutrition, and possibly both.

There are no matches between the nine animals photo-identified off Labrador and in the Davis Strait and the many animals in the extensive photo-identification catalogue for the Scotian Shelf, which contains a large proportion of the population there (H. Whitehead and T. Wimmer, unpublished).

In a pollutant analysis, three animals sampled from the Baffin Bay-Davis Strait-Labrador Sea population had significantly higher scores for expression of CYP1A1 (a biomarker for exposure to some contaminants including polycyclic aromatic hydrocarbons) compared with 33 animals sampled from the Scotian Shelf population (MANOVA, $p<0.001$), but measured blubber contaminant levels in the whales from Labrador were substantially and significantly lower than those of animals sampled off Nova Scotia (Hooker *et al.* 2008).

Another line of evidence proposed by Whitehead *et al.* (1997a) is a possible difference in the seasonality of reproduction. Based on analysis of 251 fetuses from whales killed off Labrador, Benjaminsen (1972) inferred that births took place mainly in April, May, and June, with a “peak” in April. Observations of what appeared to be newborn calves on the Scotian Shelf in August led Whitehead *et al.* (1997a, 1997b) to conclude that at least some parturition occurs in mid- to late summer.

The methodology of the mark-resight estimation of the Scotian Shelf population (Whitehead and Wimmer 2005) means that if there were much interchange between the Scotian Shelf and Baffin Bay-Davis Strait-Labrador Sea populations, the resulting estimate would include animals from both areas. However, the estimate of the Scotian Shelf population is not large (only 121-214), which means that if there were frequent exchange of animals between the two regions, then the large region occupied by the Baffin Bay-Davis Strait-Labrador Sea population would contain very few whales as well.

It is unknown whether animals sighted between the Scotian Shelf and the Labrador Sea, for instance off the Grand Banks (Figure 3) and south of Newfoundland during systematic aerial surveys (Lawson and Gosselin 2009), belong to either of these populations, or form another distinct population.

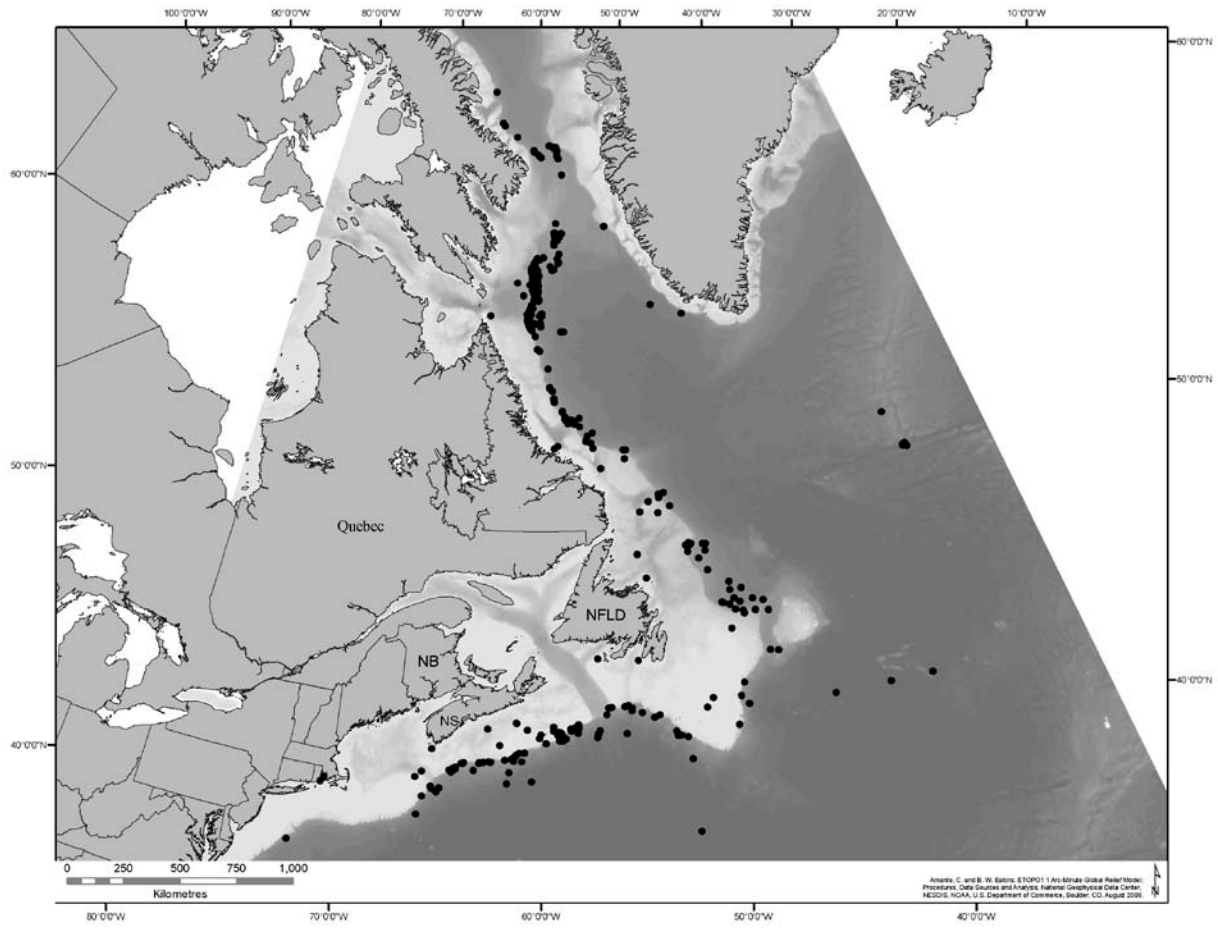


Figure 3. Sightings of Northern Bottlenose Whales (black dots) off Canada and in adjacent waters (n=16,808) between 1867 and 2010. Many sightings are superimposed, especially in the Gully. Data sources provided under ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED. Certainty of identification is variable, depending on source.

There has been little study of relationships between either of the two Canadian areas of concentration and those in the eastern North Atlantic, and among the eastern North Atlantic centres. However Dalebout *et al.* (2006) compared 23 genetic samples collected off Iceland with those collected off Nova Scotia and Labrador. The Icelandic samples appeared distinct from those of the Scotian Shelf population (microsatellites: FST= 0.0276, P< 0.0001; mtDNA: ΦST= 0.0315, P=0.12) but not from those of the Baffin Bay-Davis Strait-Labrador Sea population (microsatellites: FST= 0.0000, P=0.40; mtDNA: ΦST= -0.0150, P=0.72).

Designatable units

The Scotian Shelf and Baffin Bay-Davis Strait-Labrador Sea populations are genetically distinct based on both mtDNA and microsatellite data (see evidence from Dalebout *et al.* 2006 summarized above). Of the five mtDNA haplotypes found by Dalebout *et al.* (2006), one ("HapC") was found in 16% (20/126) of the samples from the Baffin Bay-Davis Strait-Labrador Sea population but not found (0/34) in the samples from the Scotian Shelf population. The three other common haplotypes were found in both populations (one haplotype was found in only one animal). The centres of concentration in the Davis Strait and off the Scotian Shelf are about 1,400 km apart. Although Northern Bottlenose Whales occur in the deep waters between Labrador and the Scotian Shelf (Figure 3), no consistent areas of concentration have been identified in this gap.

Northern Bottlenose Whales in the Baffin Bay-Davis Strait-Labrador Sea population and the Scotian Shelf population occur in different ecological zones. As described below, the Scotian Shelf population primarily uses three large and prominent submarine canyons (Wimmer and Whitehead 2004), whereas the animals in the Baffin Bay-Davis Strait-Labrador Sea population apparently are more widely distributed (Reeves *et al.* 1993) in a region lacking bathymetric features that are as pronounced as the Scotian Shelf canyons. In winter, sea ice cover is an important attribute of much of the Baffin Bay-Davis Strait-Labrador Sea habitat, whereas sea ice is rarely present off the Scotian Shelf. In summer, sea surface temperatures are about 5^{o}C in the Baffin Bay-Davis Strait-Labrador Sea habitat and 15-20^{o}C off the Scotian Shelf. The primary prey species of the Baffin Bay-Davis Strait-Labrador Sea whales is the squid *Gonatus fabricii* while that of the Scotian Shelf animals is the squid *G. steenstrupi* (see below).

The ecological setting of the Scotian Shelf population is unusual as this is the most southern, and warmest, known area of concentration for this species. Those differences, together with their strongly canyon-based habitat use, may have caused local adaptations, such as smaller body size, in the Scotian Shelf whales (Whitehead *et al.* 1997b).

There is thus considerable evidence of both discreteness and significance, supporting two designatable units for the Northern Bottlenose Whale in Canada: off the Scotian Shelf and in the waters off Labrador and in Davis Strait and southern Baffin Bay (Figure 4).

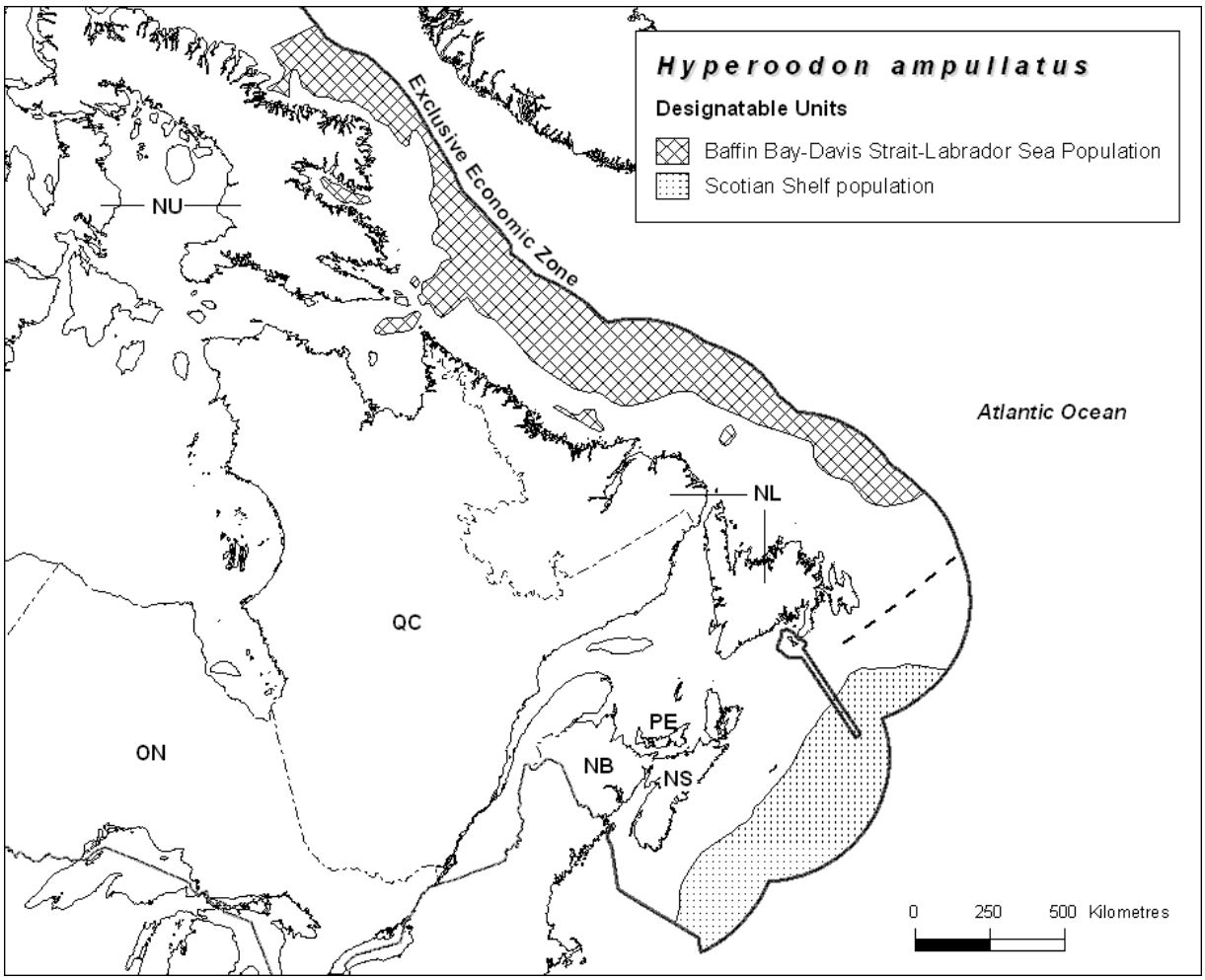


Figure 4. Designatable units for Northern Bottlenose Whale. The broken line provides an arbitrary boundary between the two recognized DUs. It follows the boundary separating Division 3L from Divisions 3N and 3O used by the North Atlantic Fisheries Organization (NAFO). See text for discussion.

There are no data to indicate where these DUs should be separated, and there are sightings of the species along the shelf edge in intervening waters (Figure 3). The lack of suitable habitat for the whales within Canadian waters east of Newfoundland (Figure 4) provides an administrative break, but there is uncertainty about the "DU status" of the whales at the southern end of the range of the Baffin Bay-Davis Strait-Labrador DU and the eastern end of the Scotian Shelf DU's range as these are shown in Figure 4.

COSEWIC does not have agreed guidelines on marine ecozones (or biogeographic zones) as it does for terrestrial and aquatic species (COSEWIC 2011). However, in November 2009 a COSEWIC working group provided some guidance in this regard, including a proposed marine ecozone map based on DFO (2009) and Powles *et al.* (2004). The proposed boundaries of the two Northern Bottlenose Whale DUs as shown in Figure 4 align reasonably well with the so-called Gulf Stream (Scotian Shelf DU) and Labrador Sea (Baffin Bay-Davis Strait-Labrador Sea DU) ecozones,

whereas most of the sightings shown on Figure 3 that do not “fit” into one of the two DU areas are either in the so-called Southern Grand Banks ecozone or outside the Canadian Exclusive Economic Zone.

A line to separate the two DUs has been drawn on Figure. 4 based on the boundary used by the North Atlantic Fisheries Organization (NAFO) to separate Division 3L from Divisions 3N and 3O. This line is for administrative convenience and is not science-based. Direct investigation of the genetic, morphological, and ecological characteristics of Bottlenose Whales found between the Scotian Shelf and Labrador Sea will be necessary for scientifically credible delineation of the DU boundaries.

Special significance

A substantial part of the worldwide range of Northern Bottlenose Whales lies in Canadian waters. They are exceptional divers, usually descending to depths greater than 800m for periods lasting up to 70 minutes (Hooker and Baird 1999). Northern Bottlenose Whales are known for their inquisitiveness, frequently approaching vessels (Mead 1989). The animals off the Scotian Shelf are the subjects of the most detailed research on any population of live beaked whales (e.g. Gowans *et al.* 2001; Hooker and Baird 2001; Hooker *et al.* 2001; Hooker and Whitehead 2002; Hooker *et al.* 2002a; Hooker *et al.* 2002b; Wimmer and Whitehead 2004).

DISTRIBUTION

Global range

Northern Bottlenose Whales are found in deep waters of the northern North Atlantic (> 500m) north of about 40^{o}N (Figure 2). However, apart from the population found along the Scotian Shelf, and sporadic sightings in the Azores, they are rarely seen south of 55^{o}N. Concentrations are found around Iceland and Svalbard, off Norway, off Labrador and in Davis Strait and southern Baffin Bay, and along the Scotian Shelf.

Canadian range

The range of the Northern Bottlenose Whale includes all waters off the Canadian east coast deeper than 500m. However, the animals are strongly concentrated along the continental slope (depths 800-1,500m), with two major concentrations off northern Labrador and in Davis Strait and the southern part of Baffin Bay and off the eastern Scotian Shelf (Reeves *et al.* 1993) (Figure 3 and Figure 4). Although Northern Bottlenose Whales must transit the relatively shallow (approximately 500m) Davis Strait Rise (approximately 66^{o}N) to reach the southern reaches of Baffin Bay where they are sighted (MacDonald 2005) (Figure 3), it is unknown whether they use the deeper waters of northern Baffin Bay. There is a reliable sighting of a mother and calf at latitude 70.45ºN off the entrance of Clyde Inlet in Baffin Bay in mid-August 2007 (Richard pers. comm. 2010). Fisheries and Oceans Canada has received reports of Northern

Bottlenose Whales “chasing squid in shallower nearshore waters on both the north and south coasts of Newfoundland on several occasions” (Lawson pers. comm. 2010a).

Off northern Labrador, Northern Bottlenose Whales seem to have a continuous distribution between the 1,000m and 2,000m contours, whereas off the Scotian Shelf they are concentrated in three large submarine canyons, the Gully, Shortland canyon and Haldimand canyon (Figure 5), in waters 800-1,500m deep (Wimmer and Whitehead 2004; Compton 2005). The Scotian Shelf canyons can be considered locations as defined by COSEWIC, as a single threatening event, such as an oil spill, could rapidly affect all whales present in a given canyon. There is no evidence of temporal change in the distribution of Bottlenose Whales.

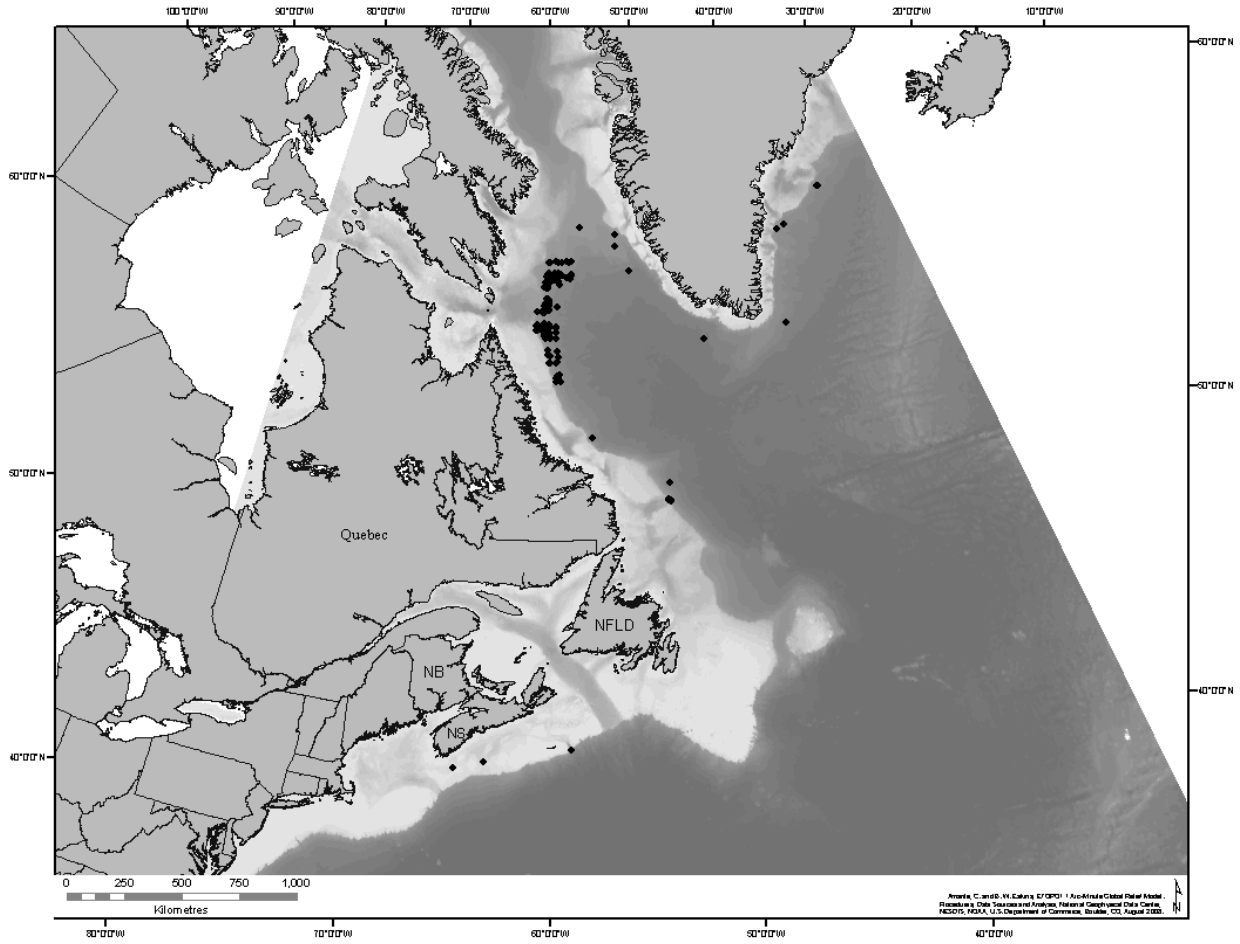


Figure 5. Locations of Northern Bottlenose Whales (black dots) taken during whaling operations in Canadian and adjacent waters (n=829 locations) between 1967 and 1971. Many catches are superimposed, especially in the Gully.

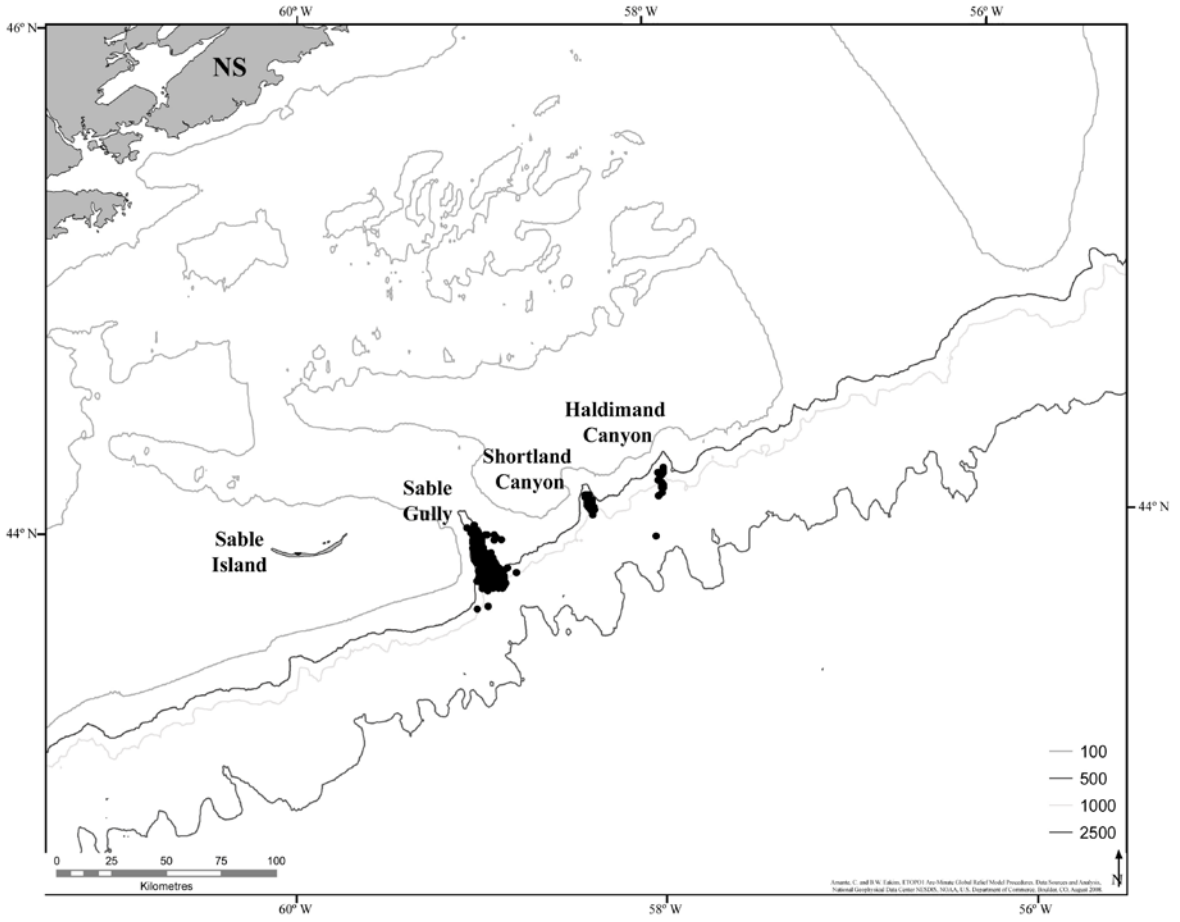


Figure 6. Locations of Northern Bottlenose Whale photo-identifications between 1988 and 2009 off the Scotian Shelf (n=16,159). Many locations are superimposed.

Based on the distribution of sightings and catches (Figures 3-5), the extent of occurrence for the species in Canada is estimated to be 2,823,276km^2 (convex polygon around all waters off the Canadian east coast south of 70^{o}N >500m deep) and the index of area of occupancy is 313,996km^2 (all waters off the Canadian east coast south of 70^{o}N between 500-2,000m deep; 2kmx2km: 78,499 grids). For the Baffin Bay-Davis Strait-Labrador Sea DU, the extent of occurrence is estimated to be 779,516km^2 (convex polygon around eastern Canadian waters between 54-70^{o}N and >500m deep) and the index of area of occupancy is 208,756km^2 (Canadian waters between 54-70^{o}N and between 500-2,000m deep; 2km x2km: 52,189 grids). For the Scotian Shelf DU the extent of occurrence is estimated to be 89,422km^2 (convex polygon around eastern Canadian waters between 57-60^{o}W, south of 47^{o}N and >500m deep) and the index of area of occupancy is 9,756km^2 (eastern Canadian waters between 57-60^{o}W, south of 47^{o}N and 500-2,000m deep; 2kmx2km: 2,439 grids). A smaller index of area of occupancy would apply if only the three main canyons (Gully, Shortland, and Haldimand) were considered, but since the whales in this DU are known to occur in other areas as well, there is no justification for choosing that option.

Search effort

Search effort has been extremely uneven over times and areas covered. Between 1988 and 2002, researchers from Dalhousie University spent 1,540 hours searching in the Gully, 114 in Shortland Canyon, and 94 in Haldimand Canyon (Wimmer and Whitehead 2004). Fisheries and Oceans Canada targeted the species during research in the three canyons in 2005 (Gosselin and Lawson 2005). Two targeted, boat-based, visual and acoustic surveys by H. Whitehead for this species were conducted along the 1,000m contour in Canadian waters. In the first survey, which covered the edge of the Scotian Shelf and adjacent waters (U.S. border to 54^{o}28'W) in 2001, Northern Bottlenose Whales were located only in the Gully and in Shortland and Haldimand Canyons (Wimmer and Whitehead 2004). In the second survey, which covered the entire 1,000m contour off Labrador and in the Davis Strait between 55^{o}18' and 61^{o}40.5'N in 2003, there were eight confirmed sightings of Northern Bottlenose Whales (Herfst 2004).

The only large-scale systematic data on Northern Bottlenose Whales in Canada come from the well-designed and comprehensive aerial survey of all eastern Canadian waters in 2007, part of the Trans North Atlantic Sightings Survey (TNASS) (Lawson and Gosselin 2009).

The effort of whalers whose catch positions are plotted in Figure 4 was highly concentrated off the eastern Scotian Shelf and in the Davis Strait, the areas where they expected to find the whales (Reeves *et al.* 1993).

Incidental sightings from other sources, such as fisheries observers and Fisheries and Oceans Canada research vessels, come from effort that is less clumped, but still far from even, and the species identifications are sometimes uncertain (Wimmer and Whitehead 2004). In recent years, Fisheries and Oceans Canada has made particular effort to collect sightings and photographic records of the species from fishersoperating off the coast of Labrador (Lawson pers. comm. 2010a).

HABITAT

Habitat requirements

Northern Bottlenose Whales occur in deep (>500m), northern waters of the North Atlantic, generally with depths between 800 and 1,500m, along the continental slope (Benjaminsen and Christensen 1979; Reeves *et al.* 1993; Wimmer and Whitehead 2004). These water depths seem to coincide with their dive depths (Hooker and Baird 1999), perhaps indicating that the whales often forage near the bottom.

The Northern Bottlenose Whales of the Scotian Shelf are most commonly sighted in three large canyons, the Gully, Shortland Canyon and Haldimand Canyon (Figure 5). Rates of sighting and detection in the canyons and other waters along the edge of the

Scotian Shelf are compared in Table 1. The Gully, the largest submarine canyon off the east coast of North America, may contain about 33% of the Scotian Shelf population at any time (Gowans *et al.* 2000). The Northern Bottlenose Whale, and especially the Scotian Shelf population, is, by cetacean standards, a habitat specialist.

Table 1. Rates of detecting Northern Bottlenose Whales in scientific boat-based sighting surveys by H. Whitehead laboratory (Dalhousie University) and on "pop-up" hydrophone recorders deployed at depths of about 1,000 m for periods of months.

	Sighting rate encounters/hr (effort in hrs) (Herfst 2004; Wimmer and Whitehead 2004; Compton 2005)	**Rates of hearing clicks of Northern Bottlenose Whales (clicks/min) (Moors pers. comm. 2010)**
The Gully	0.50 (1,450)	35.0
Shortland Canyon	0.29 (114)	22.9
Haldimand Canyon	0.14 (94)	26.6
Other Scotian Slope waters	0.00 (154)	9.7*
Labrador-Davis Strait	(321)	-

Mean of values from 2 stations about 25 km east and west of the Gully

Habitat trends

There is no indication of trends in area of available habitat for Northern Bottlenose Whales in Canada. Habitat quality for many cetaceans may be declining because of increases in ocean noise (NRC 2003), to which Northern Bottlenose Whales may be particularly susceptible (Houser *et al.* 2001).

BIOLOGY

Much of the information on the biology of the Northern Bottlenose Whale comes from two sources: analyses of specimens killed by Norwegian whalers (e.g. Benjaminsen 1972; Christensen 1973; Benjaminsen and Christensen 1979), and studies of living individually photoidentified animals off the Scotian Shelf and particularly in the Gully (e.g. Gowans *et al.* 2001; Hooker *et al.* 2002b; Wimmer and Whitehead 2004).

Life cycle and reproduction

Females become sexually mature at 8-13 years old and males at 7-9 (Benjaminsen and Christensen 1979). Whaling data suggest that females give birth to single offspring about every two years after a gestation of about 12 months (Benjaminsen and Christensen 1979), although observations of calves in the Scotian Shelf population suggest that the reproductive rate is lower than this: in the Gully between 1988 and 1999, only 6% of 3,113 sightings of Northern Bottlenose Whales close enough to the research vessel to be photoidentified (<~100m) were recorded as first-year calves (H. Whitehead, unpublished data). The life span is at least 37 years

(Christensen 1973). The generation time is estimated at about 15.5 years, which is the mean age of the 26 females in the sample of animals killed by whalers in the Davis Strait that were older than the mean age of sexual maturity (data from Christensen 1973). This was interpreted by the Marine Mammal Specialists Sub-committee as a reasonable estimate of the average age of parents of the current cohort (i.e. newborn individuals in the population). Using a different method (a 5-parameter demographic model designed to obtain "default" estimates of generation length and percent mature for IUCN assessments), Taylor *et al.* (2007) estimated the generation length as 17.8 years for the Northern Bottlenose Whale, which is not greatly different from the estimate of 15.5 years derived directly from whaling data.

Physiology and adaptability

The Northern Bottlenose Whale is well adapted to its deep-diving lifestyle, but there have been no detailed studies of this adaptation. The inquisitiveness of the species, as well as its social structure (a loose network of relationships among females, and strong bonds between pairs of males), may be related to the consistent use of what are, by cetacean standards, small ocean areas (Gowans *et al.* 2001). A consequence of their tendency to approach vessels is that Bottlenose Whales were easily captured by whalers.

Dispersal and migration

The available evidence suggests that the Scotian Shelf population does not make seasonal migrations. Rates of acoustic detection of the animals on "pop-up" hydrophones placed in the Gully are similar in all 12 months (Moors pers. comm. 2010), and there are photo identification matches of individuals between seasons (Whitehead *et al.* 1997b). Animals move between the three large canyons on the eastern Scotian Shelf (the Gully, Shortland Canyon, Haldimand Canyon, which are arranged along the shelf edge at intervals of about 50km, Figure 5) but show individual preferences for particular canyons (Wimmer and Whitehead 2004).

Little is known about the movements of Baffin Bay-Davis Strait-Labrador Sea animals or whether they make seasonal migrations. However, there have been sightings of Northern Bottlenose Whales in the Baffin Bay-Davis Strait-Labrador Sea area in winter, perhaps indicating a lack of consistent seasonal migration (Reeves *et al.* 1993). It is believed, based on patterns of sighting and catching, that Northern Bottlenose Whales in the northeastern Atlantic migrate north-south seasonally (see summary in Benjaminsen and Christensen 1979).

Interspecific interactions

While Northern Bottlenose Whales are known to eat various deep-water fishes and squids, they particularly favour deep-water squids of the genus *Gonatus* (Mead 1989). In consequence, they have a particularly narrow ecological niche compared with other deep-diving mammals (Whitehead *et al.* 2003). In the more northern parts of the range,

including the Baffin Bay-Davis Strait-Labrador Sea habitat, their primary food is *Gonatus fabricii* (Mead 1989), whereas in more temperate waters of the Scotian Shelf it is *G. steenstrupi* (Hooker *et al.* 2001).

Norwegian whalers saw Killer Whales (*Orcinus orca*) attacking Northern Bottlenose Whales, and noted scarring from previous attacks (Jonsgård 1968a, b). The deep-diving capabilities of Bottlenose Whales may help them to avoid predation by Killer Whales.

POPULATION SIZES AND TRENDS

Scotian Shelf: Sampling effort and methods

Current estimates of abundance and population trends come from mark-resight analyses of photo-identifications of individual Northern Bottlenose Whales (excluding first-year calves). The most recent published estimate uses 3,588 good photographs of individuals possessing marks that can be reliably identified over years, taken between 1988 and 2003. This estimate corrects for unidentifiable individuals, and considers heterogeneity in the probability of identification (important as most photographs were taken in the Gully), as well as mortality, mark change, and emigration (Whitehead and Wimmer 2005). Separate estimates were produced using photographs taken from the left and right sides of the animals, and then averaged. For this COSEWIC status report, the analysis was updated by adding all photo-identification data collected between 2006 and 2009 (no data were collected in 2004 or 2005). The majority of the additional data was from 2006, with a few usable photographs from 2007 and 2008 (no usable photographs from 2009). This up-to-date data set contains 3,666 high-quality photo-identifications.

Scotian Shelf: Abundance

Whitehead and Wimmer (2005) estimated that the Scotian Shelf population contained 163 adult and immature animals (95% confidence interval 119-214). The updated analysis, after adding data collected in 2006-2009, gave an estimate of 164 adult and immature animals (95% confidence interval 121-214). Of the 51 non-calf animals from the Norwegian catch off Labrador examined by Benjaminsen (1972), 57% were mature. If this proportion can be transferred to the Scotian Shelf, it suggests a population of about 93 mature individuals.

Estimates of the abundance of Northern Bottlenose Whales in the Gully from ship-based visual line transect surveys in 2005 were 44 (95% confidence interval 19-105) in April and 63 (95% confidence interval 20-230) in July (Gosselin and Lawson 2005). These estimates were not corrected to account for animals missed on the transect line because of dives, which would lead to underestimation, or for animals attracted to the research vessel through curiosity, which would lead to overestimation. As Northern Bottlenose Whales are both long divers and very curious, abundance estimates from ship-based line transect surveys are not very informative (Reeves *et al.* 1993).

The systematic TNASS aerial surveys in 2007 (Lawson and Gosselin 2009) resulted in one “sighting event”’ off Labrador (1 individual), one east of Newfoundland (4 individuals), eight south of Newfoundland (38 individuals), and three off the Scotian Shelf (6 individuals). Coverage of those areas consisted of 5,363 km flown on-effort off Labrador, 7,611 km east of Newfoundland, 10,387 km south of Newfoundland, and 9,111 km off the Scotian Shelf. It is uncertain how to account for the Newfoundland sightings, which may or may not have involved whales from the Scotian Shelf population. No abundance estimates for Bottlenose Whales were made from the TNASS survey data (Lawson and Gosselin 2009).

Scotian Shelf: Fluctuations and trends

The best population models (minimum AIC) fit to the full 1988-2009 photo-identification data sets did not include a trend parameter, indicating a stable population. If a trend parameter was added to the model, the estimated population trend was +2.1% per year (95% confidence interval -1.6%/year to +6.3%/year). This trend estimate is almost identical to that generated from the 1988-2003 data set (Whitehead and Wimmer 2005). However, the lack of support for a trend in the modelling, and the inclusion of zero within the confidence interval, mean that the hypothesis that the population size has not changed since 1988 is not rejected.

The Gully population is not known to have been subjected to significant whaling prior to the 1960s. Between 1962 and 1967, 87 Northern Bottlenose Whales were taken from the Scotian Shelf area by whalers based in Blandford, Nova Scotia (Reeves *et al.* 1993). It is unknown whether the population has recovered from this depletion. Genetic analyses detected no signal of a population bottleneck (Dalebout *et al.* 2006).

Scotian Shelf: Rescue effect

Given the very low rate of movement between the Scotian Shelf population and the two closest areas of concentration, Baffin Bay-Davis Strait-Labrador Sea and Iceland (Dalebout *et al.* 2006, see above), the likelihood that dispersal from other populations could “rescue” the Scotian Shelf population appears low. However, if Bottlenose Whales sighted south and east of Newfoundland prove to belong to a separate population, their proximity to the area inhabited by the Scotian Shelf DU would mean that there is potential for rescue.

Baffin Bay-Davis Strait-Labrador Sea population: Population status

As stated in the **PREFACE**, the “Davis Strait population” (in effect what is now being called the Baffin Bay-Davis Strait-Labrador Sea population) was assessed (by inference) as Not at Risk in 1993. Following initial British and Norwegian hunts for Northern Bottlenose Whales in the Baffin Bay-Davis Strait-Labrador Sea area from about 1850-1890, little whaling occurred until Norwegian whalers took 818 animals between 1969-1971 (Christensen 1975; Reeves *et al.* 1993). The British whaling

apparently was driven primarily by markets for oil and spermaceti (see Reeves *et al.* 1993), whereas according to Christensen (1975) animal food was the main product of the recent Norwegian hunt. After the end of whaling in 1971, there was scientific dispute as to whether or not the hunt had depleted the species substantially across its range (Christensen *et al.* 1977; Mitchell 1977).

A number of sightings have been made in the Baffin Bay-Davis Strait-Labrador Sea area (Reeves *et al.* 1993; Herfst 2004; MacDonald 2005) (Figure 3), and the animals are frequently mentioned as being observed by fishers working in the area (see below). However, the systematic TNASS aerial surveys in 2007 encountered Northern Bottlenose Whales only once in the flights off Labrador (5,363 km flown south of Cape Chidley, the northern tip of Labrador), compared with nine encounters off eastern and southern Newfoundland (17,998 km flown) and three off the Scotian Shelf (9,111 km flown) (Lawson and Gosselin 2009). Similarly, extensive boat surveys in 2003 and 2004 through the major areas of sightings and catches off Labrador and in the Davis Strait encountered very few animals (Herfst 2004; Compton 2005), with a much lower encounter rate than in the canyons of the Scotian Shelf (Table 1). The longer 2003 survey used the same boat, methods and personnel as have been used for surveys of the Scotian Shelf canyons, and it was carried out in better weather than is usual on the Scotian Shelf. A brief survey on a fisheries research vessel in southern Baffin Bay/Davis Strait in 2004 was more productive, with 6 encounters in 25.5 hours of effort, although all but two of these encounters occurred while the vessel was fishing, and Northern Bottlenose Whales are attracted to fishing vessels in the area (MacDonald 2005).

Given the much higher catch levels, the Baffin Bay-Davis Strait-Labrador Sea population must have been considerably larger than the Scotian Shelf population prior to the last phase of whaling in 1969. The scarcity of recent encounters could mean that the Baffin Bay-Davis Strait-Labrador Sea population remains much reduced, but without more data from properly designed surveys and in the absence of any abundance estimates it can only be concluded that the status of this population is uncertain.

Baffin Bay-Davis Strait-Labrador Sea population: Rescue effect

Genetic data indicate links to the population off Iceland (Dalebout *et al.* 2006), so rescue is possible. Estimates of 4,925 (CV=0.16) and 902 (CV=0.45) Bottlenose Whales in Icelandic and Faroese waters, respectively, were made based on data from ship surveys in 1987 (Gunnlaugsson and Sigurjónsson 1990), with no correction for availability bias (animals submerged and not visible at the surface) or for ship attraction (which would bias the estimates upward). Also, as noted above for the Scotian Shelf DU, if Bottlenose Whales sighted south and east of Newfoundland prove to belong to a separate population, their proximity to the area inhabited by the Baffin Bay-Davis Strait-Labrador Sea DU would mean that there is potential for rescue from that population as well.

THREATS

Northern Bottlenose Whales in Canadian waters face three principal threats: mortality from entanglement in fishing gear (bycatch), ocean noise, and contaminants. In the cases of bycatch and noise and for both the Scotian Shelf and Baffin Bay-Davis Strait-Labrador Sea DUs, the threat is actual, but the extent of harm is uncertain. Fisheries and Oceans Canada's Recovery Potential Assessment estimated a maximum potential biological removal (PBR) of 0.3 individuals per year for the Scotian Shelf population (Harris *et al.* 2007), indicating that for this population a threat that affects just a few animals could still be harmful to the population. Concerns about the effects of contaminants apply primarily to the Scotian Shelf DU.

Northern Bottlenose Whales sometimes strand in eastern Canada (7 since 2002 in Newfoundland; Lawson pers. comm. 2010b), but the cause of death is rarely determined.

Fishery Interactions

Animals in the Baffin Bay-Davis Strait-Labrador Sea population frequently interact with offshore trawling and longlining operations (MacDonald 2005). Fisheries and Oceans Canada has collected many photographs, personal communications and observer reports of Northern Bottlenose Whales associated with fisheries for Greenland Halibut (*Reinhardtius hippoglossoides*, also called Turbot) off northern Labrador and in the western Davis Strait (Lawson pers. comm. 2010b). Some fishers complain that these whales are taking the bait or catch off the lines (perhaps exacerbated by fishers apparently feeding bait or bycatch to nearby Northern Bottlenose Whales) (Lawson pers. comm. 2010b). Several fishers claimed they were "driven from the fishery" by whale depredation, despite the use of rapid location changes or "decoy vessels" to try to lure groups of Northern Bottlenose Whales away from actively fishing vessels (Lawson pers. comm. 2010b). Lawson (2010b) notes that Greenland Halibut fishers from Greenland, working on the opposite side of the Davis Strait, do not report similar whale depredation. Some of these incidents may be attributable to Sperm Whales (*Physeter macrocephalus*), which also depredate fishing activities in the area, or to deepwater sharks; there has been no recovery of "whale-damaged"fish from lines to investigate types of damage and support inferences concerning the identity of the culprits (Lawson pers. comm. 2010b).

Since the early 1980s Fisheries and Oceans Canada has collected eight records from the At-Sea Observer program (5 from the Scotian Shelf area and 3 from Newfoundland/Labrador) of entanglement of Northern Bottlenose Whales in longlines and otter trawls, both benthic and pelagic, set for Swordfish (*Xiphius gladius*), Silver Hake (*Merluccius bilinearis*), Greenland Halibut and squid (Department of Fisheries and Oceans 2009). (The Silver Hake and squid fisheries are no longer prosecuted.) Some of these animals were cut free and may have survived. Others died. (Note: Actual numbers of animals cut free, and their condition upon release vs. numbers dead when found, were not provided to the report writers.) One dead adult was brought to the

surface entangled by the caudal peduncle in gillnet gear for Greenland Halibut in 2008 (Lawson pers. comm. 2010b). Additionally a Northern Bottlenose Whale was observed severely entangled and injured in longline gear in the Gully in 1999 (Gowans *et al.* 2000). Additional entanglements have almost certainly gone unreported, but their frequency and severity are unknown. In an analysis of markings on 100 photographs of the melons (foreheads) of the Scotian Shelf animals, Mitchell (2008) found only one example of marks indicating entanglement, and one of vessel collision. This suggests that entanglement is not a severe problem, although one death per year caused directly or indirectly by entanglement would exceed the PBR (0.3) for the Scotian Shelf population. Photographic and written observer records from the Baffin Bay-Davis Strait-Labrador Sea population fishery suggest a greater frequency of interaction than off the Scotian Shelf, for at least a portion of the Northern Bottlenose Whale population in the area (see also MacDonald 2005). Lawson (2010a) notes that some animals bear scars from fishing lines, and some have injuries that could have been caused by propellers or fishing gear.

Noise

Anthropogenic noise in the ocean is generally increasing and seen as a threat to cetaceans. Noise can have a range of deleterious effects on marine mammals, including death from stranding, permanent or temporary threshold shifts in hearing ability, masking of important sounds (e.g. from conspecifics, prey, predators, the environment, and returns from their own echolocation), displacement, and behavioural disturbance (Nowacek *et al.* 2007). However, research into the effects of anthropogenic noise on cetaceans rarely examines long-term, population-level effects, and has produced apparently contradictory results (Nowacek *et al.* 2007; Weilgart 2007). Thus the effects of ocean noise on Northern Bottlenose Whales are uncertain.

The noise sources of most concern for Northern Bottlenose Whales in Canadian waters are geophysical seismic surveys, which are sporadically intense in their habitat. The most likely effects of seismic activity on Northern Bottlenose Whales off Canada are probably displacement from preferred habitat and disruption of foraging. A variety of cetacean species have been found to move away from seismic surveys (Stone 2003), and the presence of seismic pulses negatively affects the foraging effectiveness of another deep-diving species, the Sperm Whale (Miller *et al.* 2009).

Seismic exploration activity has been variable in the Scotian Shelf and Labrador areas (Figure 7). The Gully, as a marine protected area, no longer has seismic exploration, but the sounds of surveys outside the Gully can reach into it (McQuinn and Carrier 2005). Northern Bottlenose Whales were sighted in the Gully during a 2003 seismic survey being carried out approximately 50km away, during which received noise levels from the survey were about 135-140dB re 1µPa SEL (Gosselin and Lawson 2005; McQuinn and Carrier 2005). Other important habitat for Scotian Shelf Northern Bottlenose Whales, especially Shortland and Haldimand canyons, are subject to seismic surveys. Heavy seismic exploration activity occurred in the area of Haldimand canyon between 1999 and 2003 (Figure 8). Shortland and Haldimand canyons have

been recommended as Critical Habitat in the proposed Recovery Strategy for the Scotian Shelf population (Department of Fisheries and Oceans 2009), and this could eventually lead to measures that limit the exposure of the whales to noise from seismic surveys. Seismic surveys off Labrador have so far been generally south of the principal habitat of the Baffin Bay-Davis Strait-Labrador Sea population (Figure 8).

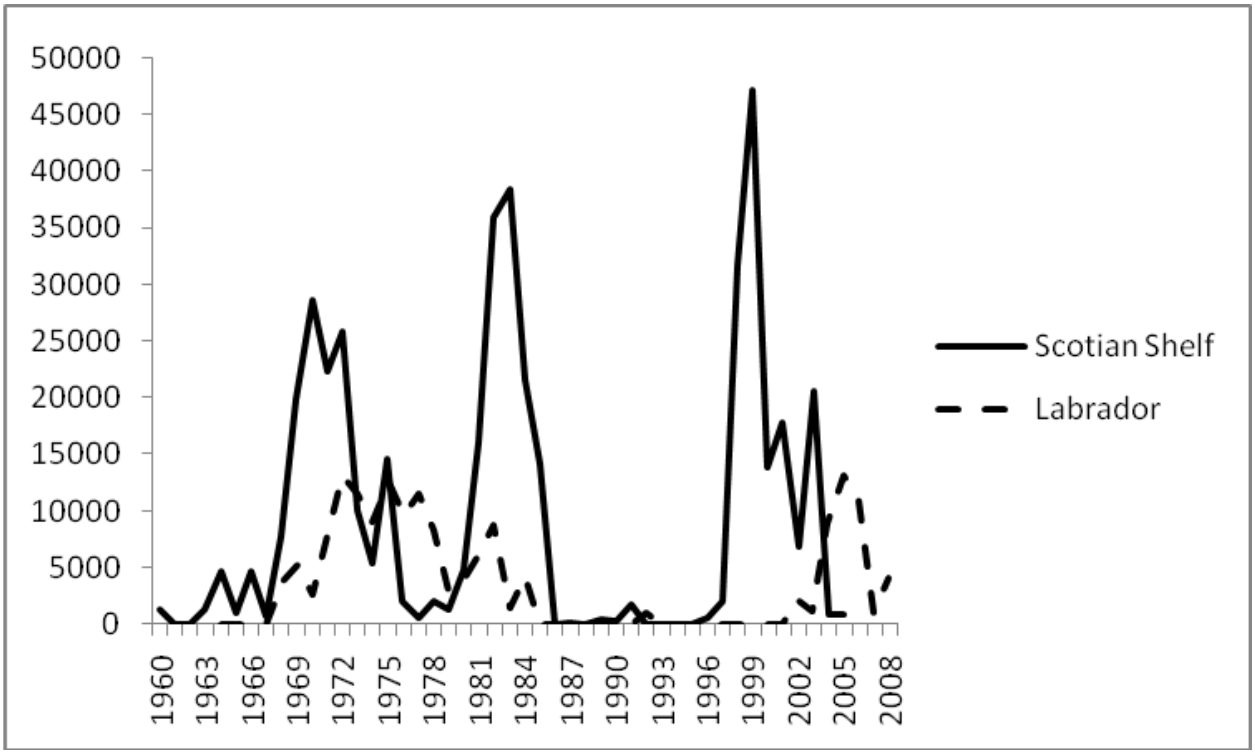


Figure 7. Kilometres of seismic exploration activity on the Scotian Shelf and off Labrador per year (Canada Nova Scotia Offshore Petroleum Board 2006; Canada Newfoundland and Labrador Offshore Petroleum Board 2009b).

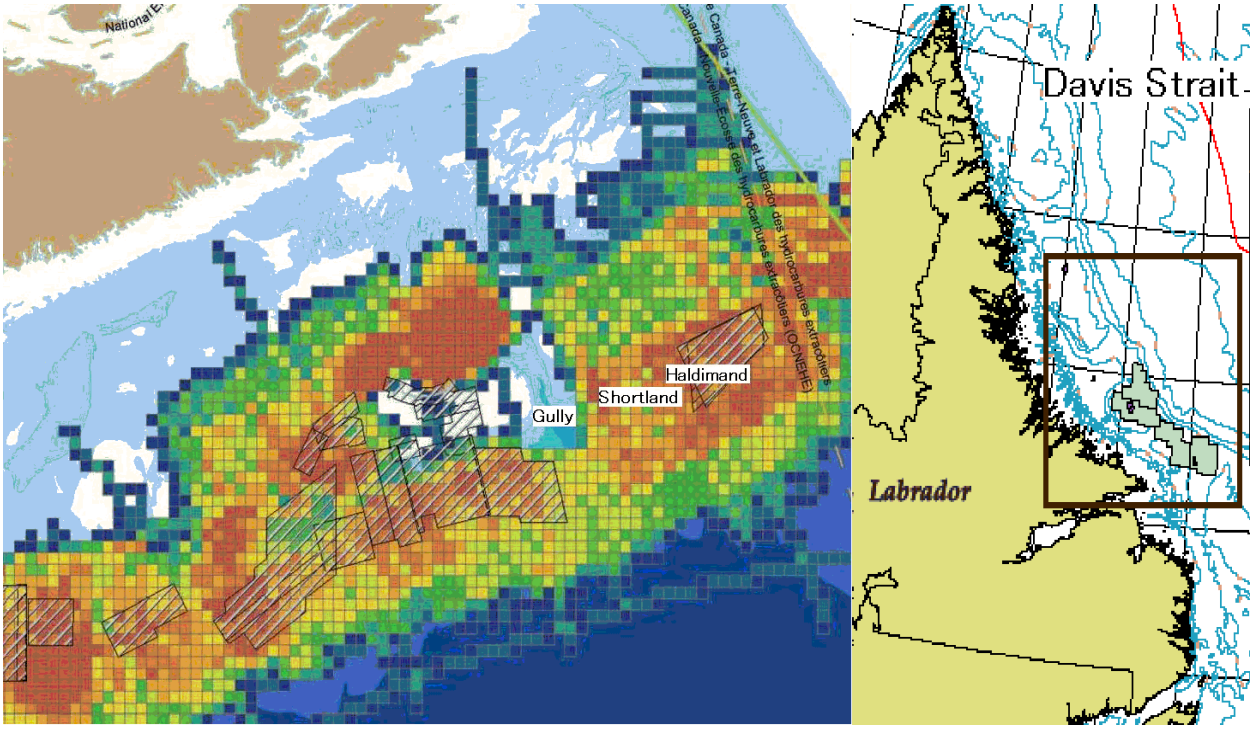


Figure 8. Seismic activity on the Scotian Shelf (left, from Department of Fisheries and Oceans 2006; in demarcated 10km by 10km cells, the colouration indicates the km of seismic testing ranging from dark blue (less than 8km) to red (73-367 km) between 1999 and 2003) and oil and gas exploration licences off Labrador (right, from Canada Newfoundland and Labrador Offshore Petroleum Board 2009; exploration licences in light green, production licences in purple).

Beaked whales are known to strand and die in response to the effects of military sonar (Weilgart 2007). Seismic operations are also occasionally implicated (Weilgart 2007). While Cuvier's Beaked Whales (*Ziphius cavirostris*) are most often involved in strandings linked to military sonar, there is a record of one Northern Bottlenose Whale in a mass stranding that included three Cuvier's Beaked Whales and two Pygmy Sperm Whales (*Kogia breviceps*) following naval exercises off the Canary Islands (Weilgart 2007). The habitat of Northern Bottlenose Whales is sufficiently far from populated coasts that most strandings are unlikely to be detected and reported. The mechanism by which loud sound can lead to whale deaths is not clear (Weilgart 2007). Houser *et al.* (2001) and Hooker *et al.* (2009) speculated that, because of their long and deep dives, Northern Bottlenose Whales may be particularly susceptible to acoustically triggered physiological damage through nitrogen accumulation in the blood and tissues, although they may be less at risk of such damage than Cuvier's Beaked Whales (Hooker *et al.* 2009).

Contaminants

Overall contaminant levels in Northern Bottlenose Whales from both the Scotian Shelf and Baffin Bay-Davis Strait-Labrador Sea populations were similar to those in other North Atlantic odontocetes (Hooker *et al.* 2008). However, in the Scotian Shelf animals there were significant increases in 4,4'-DDE and *trans*-nonachlor in 2002-2003 relative to 1996-1997, an interval during which the Sable Offshore Energy project developed near Sable Island, about 30 km from the Gully (Hooker *et al.* 2008). This change in contaminant levels, which likely reflects a temporal change in the levels in water and/or in prey species, could be due to alterations in ocean currents, but the possibility that nearby oil and gas drilling activities influenced contaminant patterns cannot be ruled out (Hooker *et al.* 2008). These organochlorine contaminants are not likely to have been released directly from drill rigs, but some aspect of the overall oil and gas operations could have led to remobilization of persistent contaminants in sediments on the Scotian Shelf (Hooker *et al.* 2008).

Hooker *et al.* (2008) also reported higher levels of the cytochrome P4501A1 (CYP1A1) protein in tissues of Northern Bottlenose Whales collected in 2003 on the Scotian Shelf compared with those from collections in 1996, 1997, and 2002, which could relate to small oil spills reported in the area in 2003. CYP1A1 in tissues reflects recent exposure to contaminants that act through the Ah receptor.

An analysis of photographs of marks on the melons of the Scotian Shelf whales found an increase in 2005-2007 compared with 1988-2003 in the prevalence of marks associated with skin disease in other odontocetes (Mitchell 2008). It is not clear whether the increases in these marks and in contaminant levels were in any way related to the industrial activity of the Sable Offshore Energy Project.

Although many studies have been carried out to document tissue contaminant levels in cetaceans, dose-response studies are rare. In the case of Bottlenose Whales, there is no information on effects, and therefore it is not possible to determine whether contaminants are an actual or imminent threat.

PROTECTION, STATUS, AND RANKS

Legal protection and status

The Northern Bottlenose Whale is listed as a "Protected Species" by the International Whaling Commission with a catch limit of zero. The species is also listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). There is currently no regular hunt for this species although it is occasionally taken in the multi-species cetacean fishery in the Faroe Islands (see Faroe Islands progress reports in annual reports of the North Atlantic Marine Mammal Commission).

In Canada, hunting and other activities deliberately harmful to Northern Bottlenose Whales are covered by the Marine Mammal Regulations of the *Fisheries Act*. The Scotian Shelf population was assessed by COSEWIC in 2002 and subsequently listed as Endangered under Schedule 1 of SARA in April 2006. A recovery strategy has been proposed (Department of Fisheries and Oceans 2009). The Baffin Bay-Davis Strait-Labrador Sea population was implicitly considered "not at risk" when the species as a whole was assessed by COSEWIC in 1993.

Non-legal status and ranks

The Northern Bottlenose Whale is listed as Data Deficient by IUCN and G4 by NatureServe. The Scotian Shelf and Baffin Bay-Davis Strait-Labrador Sea populations are listed individually as G4TNR. The General Status of the species in Canada is 3 (Sensitive).

Habitat protection and ownership

The Gully was designated as a marine protected area (MPA) in 2004 under the *Oceans Act*. The core area of the MPA (Zone 1) constitutes the primary habitat of the Northern Bottlenose Whales (Hooker *et al.* 1999; Macnab 2005). No extractive activities, including fishing, are permitted in this zone. Although oil and gas exploration and development, including seismic exploration, are not explicitly prohibited by regulations, current technologies used in this industry would not be allowable anywhere in the MPA under the regulations (Macnab 2005) (Figure 8). The regulations also restrict activities outside the MPA which could cause harm inside it, although it is not fully clear how this will be implemented (Macnab 2005). Overall the Gully MPA appears to provide substantial protection for the primary habitat of the Scotian Shelf population of Northern Bottlenose Whales. The most significant potential impacts of allowable human activity within the MPA on Northern Bottlenose Whales are from commercial shipping (approximately one commercial passage per day; H. Whitehead, Dalhousie University, unpublished) and scientific research (allowed but regulated within the MPA).

The remaining habitat of Northern Bottlenose Whales in Canada has no special protection, although Shortland and Haldimand canyons are recommended as critical habitat for the species in the proposed recovery strategy for the Scotian Shelf population (Department of Fisheries and Oceans 2009).

A few unconfirmed sightings of Northern Bottlenose Whales have been reported in the Labrador Inuit Settlement marine zone, which appears to have almost no waters deeper than 500 m (the "Zone", Government of Nunatsiavut 2005) (Figure 3). These may represent misidentifications or vagrants.

ACKNOWLEDGEMENTS AND AUTHORITIES CONTACTED

Information regarding the distribution of Northern Bottlenose Whales in Canadian waters (presented in Figure 3, Figure 4 and Figure 5) are courtesy of Garry Stenson and Jack Lawson (Fisheries and Oceans Canada, St John's), Fisheries and Oceans Canada Maritimes (data compiled by Hilary Moors), SPANS oil and gas observer program, the Right Whale Consortium (through access to the North Atlantic Right Whale Sightings database), the H. Whitehead laboratory, Dalhousie University (for photo-identification data), Tony Lock (Integrated Seabird Research Program, PIROP data compiled by the Canadian Wildlife Service, Environment Canada) and Nils Øien (Baffin Bay-Davis Strait-Labrador Sea population whaling data). The report writers would like to thank Hilary Moors for unpublished data from "pop-up" hydrophones, Leah Nemiroff for helping prepare photo identification data, Mike James (Fisheries and Oceans Canada Maritimes Species at Risk office) for information on the recovery strategy for this species, Jenny Wu (COSEWIC Secretariat) for EO and AO calculations and the preparation of Figure 4, and the coauthors of the previous report and updates for this species: Randall Reeves, Edward Mitchell, Annick Faucher, Stephen McCarrey and Shannon Gowans.

Authorities contacted

COSEWIC

Gloria Goulet, formerly of the COSEWIC Secretariat, Gatineau, Quebec

Neil Jones, Science Project Officer & ATK Coordinator, COSEWIC Secretariat, Gatineau, Quebec

Jenny Wu, Data Management and Mapping Specialist, COSEWIC Secretariat, Gatineau, Quebec

Lisa Twolan, Section Head (Science), COSEWIC Secretariat, Gatineau, Quebec

Provinces/Territories

Dr. Isabelle Schmelzer, Senior Biologist, Department of Environment & Conservation, Government of Newfoundland and Labrador, Corner Brook Newfoundland (no reply)

Shelley Moores, Senior Manager, Department of Environment & Conservation, Government of Newfoundland and Labrador, Corner Brook Newfoundland (no reply)

Dr. J. Sherman Boates, Manager, Department of Natural Resources, Government of Nova Scotia, Kentville, Nova Scotia (no reply)

Mark F. Elderkin, Wildlife Division, Department of Natural Resources, Government of Nova Scotia, Kentville, Nova Scotia

Christopher Hotson, Legislation and Management Biologist, Department of Environment, Government of Nunavut, Igloolik, Nunavut

Daniel Banville, Chef équipe biodiversité, Ministère des Ressources naturelles et de la Faune du Québec, Direction de l'expertise sur la faune et ses habitats, Québec City, Québec

Annie Levesque, Biologiste, Coordonnatrice du Centre de données sur le patrimoine naturel du Québec (Faune), Ministère des Ressources naturelles et de la Faune du Québec, Direction de l'expertise sur la faune et ses habitats, Québec City, Québec

Fisheries and Oceans Canada

Christie Whelan, Science Advisor, Fisheries and Oceans Canada, Ottawa, Ontario

Mike James, Senior Species at Risk Biologist, Fisheries and Oceans Canada, Dartmouth, Nova Scotia

Paul McNab, Biologist, Fisheries and Oceans Canada, Dartmouth, Nova Scotia

Garry Stenson, Section Head, Fisheries and Oceans Canada, St. John's, Newfoundland & Labrador

Jack Lawson, Research Scientist, Fisheries and Oceans Canada, St. John's, Newfoundland & Labrador

Mark Schowell, International Observer Biologist, Fisheries and Oceans Canada, Dartmouth, Nova Scotia (no reply)

Christopher Lewis, Fisheries Management Biologist, Fisheries and Oceans Canada, Iqaluit, Nunavut

Conservation Data Centres

Sean Blaney, Atlantic Canada Conservation Data Centre, Sackville, New Brunswick

Stefan Gerriets, Senior Data Manager, Atlantic Canada Conservation Data Centre, Sackville, New Brunswick

Wildlife Management Boards

Nicole Gougeon, Secretary-Treasurer, Hunting, Fishing and Trapping Coordinating Committee, Montreal, Quebec

Robert Kidd, Director of Wildlife Management, Nunavut Wildlife Management Board, Iqaluit, Nunavut

Adam Schneidmiller, Wildlife Management Biologist, Nunavut Wildlife Management Board, Iqaluit, Nunavut

Juliana Coffey and Beverly Blake, Fish Biologist, Torngat Joint Fisheries Board, Mount Pearl, Newfoundland & Labrador (no reply)

INFORMATION SOURCES

Benjaminsen, T. 1972. On the biology of the bottlenose whale, *Hyperoodon ampullatus* (Forster). Norwegian Journal of Zoology 20:233-241.

Benjaminsen, T., and I. Christensen. 1979. The natural history of the bottlenose whale, *Hyperoodon ampullatus* (Forster). Pp. 143-164 *in* H.E. Winn, and B.L. Olla (eds.). Behavior of Marine Animals. Volume 3. Plenum, New York.

Canada Newfoundland and Labrador Offshore Petroleum Board. 2009. Newfoundland and Labrador offshore region. License information. Web site: http://www.cnlopb.nl.ca/maps/onl_2009.pdf [accessed August 2009].

Christensen, I. 1973. Age determination, age distribution and growth of bottlenose whales, *Hyperoodon ampullatus* (Forster), in the Labrador Sea. Norwegian Journal of Zoology 21:331-340.

Christensen, I. 1975. Preliminary report on the Norwegian fishery for small whales: expansion of Norwegian whaling to arctic and northwest Atlantic waters, and Norwegian investigations of the biology of small whales. Journal of the Fisheries Research Board of Canada 32:1083-1094.

Christensen, I., Å. Jonsgård, and C. J. Rorvik. 1977. Some notes concerning the bottlenose fishery in the North Atlantic after the Second World War, with particular reference to the westward expansion. Reports of the International Whaling Commission 27:226-227.

Compton, R. 2005. Predicting key habitat and potential distribution of northern bottlenose whales (*Hyperoodon ampullatus*) in the Northwest Atlantic Ocean. MSc dissertation, University of Plymouth, Plymouth, U.K.

COSEWIC. 2011. Operations and Procedures Manual February 2011.

Dalebout, M.L., D.E. Ruzzante, H. Whitehead, and N.I. Øien. 2006. Nuclear and mitochondrial markers reveal distinctiveness of a small population of bottlenose whales (*Hyperoodon ampullatus*) in the western North Atlantic. Molecular Ecology 15:3115-3129.

Department of Fisheries and Oceans. 2006. Scotian Shelf: An atlas of human activities. Oil and gas industry. Web site: http://www.mar.dfo-mpo.gc.ca/oceans/e/essim/atlas/oil-e.html [accessed August 2009].

Department of Fisheries and Oceans. 2009. Recovery strategy for the Northern Bottlenose Whale, Scotian Shelf population, in Atlantic Canadian waters [Proposed]. 60 pp.

DFO 2009. Development of a framework and principles for the biogeographic classification of Canadian marine areas. Can. Sci. Adv. Sect. Sci. Adv. Rep. 2009/056 DRAFT. 17 pp. (advance copy from DFO – to be posted on CSAS website)

Gosselin, J.F., and J. Lawson. 2005. Distribution and abundance indices of marine mammals in the Gully and two adjacent canyons of the Scotian Shelf before and during nearby hydrocarbon seismic exploration programs in April and July, 2003. Pp. 117-138 *in* K. Lee, H. Bain, and G. V. Hurley (eds.). Acoustic Monitoring and Marine Mammal Surveys in the Gully and Outer Scotian Shelf before and during Active Seismic Programs. Environmental Studies Research Funds Report no. 151. Fisheries and Oceans Canada, Dartmouth, Nova Scotia.

Government of Nunatsiavut. 2005. Labrador Inuit land claims agreement. Web site: http://www.nunatsiavut.com/pdfs/Landclaim_Poster.pdf [accessed August 2009].

Gowans, S., H. Whitehead, J.K. Arch, and S.K. Hooker. 2000. Population size and residency patterns of northern bottlenose whales (*Hyperoodon ampullatus*) using the Gully, Nova Scotia. Journal of Cetacean Research and Management 2:201-210.

Gowans, S., H. Whitehead, and S.K. Hooker. 2001. Social organization in northern bottlenose whales (*Hyperoodon ampullatus*): not driven by deep water foraging? Animal Behaviour 62:369-377.

Gunnlaugsson, T., and J. Sigurjónsson. 1990. NASS-87: Estimation of whale abundance based on observations made onboard Icelandic and Faroese survey vessels. Reports of the International Whaling Commission 40:571-580.

Harris, L.E., C.L. Waters, R.K. Smedbol, and D.C. Millar. 2007. Assessment of the recovery potential of the Scotian Shelf population of northern bottlenose whale, *Hyperoodon ampullatus.* DFO Can. Sci. Advis. Sec. Res. Doc. 2007/078.

Herfst, D. 2004. Distribution of northern bottlenose whales, *Hyperoodon ampullatus*, along the coast of Labrador, Canada. Honours BSc dissertation, Dalhousie University, Halifax, Nova Scotia.

Hooker, S.K., T.L. Metcalfe, C.D. Metcalfe, C.M. Angell, J.Y. Wilson, M.J. Moore, and H. Whitehead. 2008. Changes in persistent contaminant concentration and CYP1A1 protein expression in biopsy samples from northern bottlenose whales, *Hyperoodon ampullatus*, following the onset of nearby oil and gas development. Environmental Pollution 152:205-216.

Hooker, S.K., R.W. Baird, and A. Fahlman. 2009. Could beaked whales get the bends? Effect of diving behaviour and physiology on modelled gas exchange for three species: *Ziphius cavirostris*, *Mesoplodon densirostris* and *Hyperoodon ampullatus*. Respiratory Physiology & Neurobiology 167:235-246.

Hooker, S.K., and R.W. Baird. 1999. Deep-diving behaviour of the northern bottlenose whale, *Hyperoodon ampullatus* (Cetacea: Ziphiidae). Proceedings of the Royal Society of London, B 266:671-676.

Hooker, S.K., and R.W. Baird. 2001. Diving and ranging behaviour of odontocetes: a methodological review and critique. Mammal Review 31:81-105.

Hooker, S.K., S.J. Iverson, P. Ostrom, and S.C. Smith. 2001. Diet of northern bottlenose whales as inferred from fatty acid and stable isotope analyses of biopsy samples. Canadian Journal of Zoology 79:1442-1454.

Hooker, S.K., and H. Whitehead. 2002. Click characteristics of northern bottlenose whales (*Hyperoodon ampullatus*). Marine Mammal Science 18:69-80.

Hooker, S.K., H. Whitehead, and S. Gowans. 1999. Marine protected area design and the spatial and temporal distribution of cetaceans in a submarine canyon. Conservation Biology 13:592-602.

Hooker, S.K., H. Whitehead, and S. Gowans. 2002a. Ecosystem consideration in conservation planning: energy demand of foraging bottlenose whales (*Hyperoodon ampullatus*) in a marine protected area. Biological Conservation 104:51-58.

Hooker, S.K., H. Whitehead, S. Gowans, and R.W. Baird. 2002b. Fluctuations in distribution and patterns of individual range use of northern bottlenose whales. Marine Ecology Progress Series 225:287-297.

Houser, D.S., R. Howard, and S. Ridgway. 2001. Can diving-induced tissue nitrogen supersaturation increase the chance of acoustically driven bubble growth in marine mammals? Journal of Theoretical Biology 213:183-195.

Jonsgård, Å. 1968a. Another note on the attacking behaviour of killer whale (*Orcinus orca*). Norsk Hvalfangst-Tidende 57:175-176.

Jonsgård, Å. 1968b. A note on the attacking behaviour of killer whale (*Orcinus orca*). Norsk Hvalfangst-Tidende 57:84.

Lawson, J., pers. comm. 2010a. *Comments passed to H. Whitehead by G. Stenson.* April 2010. Biologist, Department of Fisheries and Oceans, St John's, Newfoundland.

Lawson, J., pers. comm. 2010b. *Email correspondence to T. Wimmer.* January 2010. Biologist, Department of Fisheries and Oceans, St John's, Newfoundland.

Lawson, J.W., and J.F. Gosselin. 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's marine megafauna survey - a component of the 2007 TNASS. 2009/031 34 pp.

MacDonald, R.A. 2005. Distribution and fisheries interactions of northern bottlenose whales (*Hyperoodon ampullatus*) in Davis Strait/Baffin Bay. BSc Honours dissertation, Dalhousie University, Halifax, Nova Scotia. 27 pp.

Mc Nab, P. 2005. The Gully Marine Protected Area and northern bottlenose whales on the Scotian Shelf. Pp. 1-14 *in* K. Lee, H. Bain, and G.V. Hurley (eds.). Acoustic Monitoring and Marine Mammal Surveys in the Gully and Outer Scotian Shelf before and during Active Seismic Programs. Environmental Studies Research Funds Report no. 151. Department of Fisheries and Oceans, Dartmouth, Nova Scotia.

McQuinn, I.H., and D. Carrier. 2005. Far-field measurements of seismic airgun array pulses in the Nova Scotia Gully Marine Protected Area. *in* K. Lee, H. Bain, and G.V. Hurley (eds.). Acoustic Monitoring and Marine Mammal Surveys in the Gully and Outer Scotian Shelf before and during Active Seismic Programs. Environmental Studies Research Funds Report no. 151. Department of Fisheries and Oceans, Dartmouth, Nova Scotia.

Mead, J.G. 1989. Bottlenose whales *Hyperoodon ampullatus* (Forster, 1770) and *Hyperoodon planifrons* Flower, 1882. Pp. 321-348 *in* S. H. Ridgway, and R. Harrison (eds.). Handbook of Marine Mammals. Volume 4. Academic Press, London.

Miller, P.J.O., M.P. Johnson, P.T. Madsen, N. Biassoni, M. Quero, and P.L. Tyack. 2009. Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico. Deep-Sea Research I 56:1168-1181.

Mitchell, E. 1977. Evidence that the northern bottlenose whale is depleted. Reports of the International Whaling Commission 27:195-203.

Mitchell, J.E. 2008. Prevalence and characteristics of melon markings on northern bottlenose whales (*Hyperoodon ampullatus*) in the Gully and the effects of the Marine Protected Area on marks of anthropogenic origin. BSc Honours dissertation, Dalhousie University, Halifax, Nova Scotia. 53 pp.

Moors, H., pers. comm. 2010. *Email correspondence to H. Whitehead.* March 2010. PhD candidate, Dalhousie University.

Nowacek, D.P., L.H. Thorne, D.W. Johnston, and P.L. Tyack. 2007. Responses of cetaceans to anthropogenic noise. Mammal Review 37:81-115.

NRC. 2003. Ocean Noise and Marine Mammals. National Academy Press, Washington, DC.

Powles, H., V. Vendette, R. Siron and R. O'Boyle. 2004. Proceedings of the Canadian Marine Ecoregions Workshop. Can. Sci. Adv. Sect. Proc. Ser. 2004/015: 54 pp.

Reeves, R.R., E. Mitchell, and H. Whitehead. 1993. Status of the northern bottlenose whale, *Hyperoodon ampullatus*. Canadian Field-Naturalist 107:490-508.

Rice, D.W. 1998. Marine Mammals of the World: Systematics and Distribution. The Society for Marine Mammalogy, Lawrence, KS.

Richard, P., pers. comm. 2010. E-mail correspondence to H. Whitehead. September 2010. Research Scientist, Department of Fisheries and Oceans, Winnipeg, Manitoba.

Stone, C.J. 2003. The effects of seismic activity on marine mammals in UK waters, 1998-2000. JNCC Report No. 323 78 pp.

Weilgart, L.S. 2007. The impacts of anthropogenic noise on cetaceans and implications for management. Canadian Journal of Zoology 85:1091-1116.

Whitehead, H., A. Faucher, S. Gowans, and S. McCarrey. 1997a. Status of the northern bottlenose whale, *Hyperoodon ampullatus*, in the Gully, Nova Scotia. Canadian Field Naturalist 111:287-292.

Whitehead, H., S. Gowans, A. Faucher, and S.W. McCarrey. 1997b. Population analysis of northern bottlenose whales in the Gully, Nova Scotia. Marine Mammal Science 13:173-185.

Whitehead, H., C.D. MacLeod, and P. Rodhouse. 2003. Differences in niche breadth among some teuthivorous mesopelagic marine mammals. Marine Mammal Science 19:400-406.

Whitehead, H., and T. Wimmer. 2005. Heterogeneity and the mark-recapture assessment of the Scotian Shelf population of northern bottlenose whales (*Hyperoodon ampullatus*). Canadian Journal of Fisheries and Aquatic Sciences 62:2573-2585.

Wimmer, T., and H. Whitehead. 2004. Movements and distribution of northern bottlenose whales, *Hyperoodon ampullatus*, on the Scotian Slope and in adjacent waters. Canadian Journal of Zoology 82:1782-1794.

BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Hal Whitehead has been studying cetaceans for 30 years, in various locations around the world. A large part of this work has involved the populations off the east coast of Canada, in particular those of the Northern Bottlenose Whale. He has a PhD in Zoology from Cambridge University (U.K.) and is a University Research Professor in the Biology Department, Dalhousie University. He has been a member of the IUCN Cetacean Specialist Group since 1983, was co-chair of the Marine Mammals SSC and member of COSEWIC between 2001 and 2004, and has been a member of the Marine Mammals SSC since 2004. He has published 147 refereed papers and 17 refereed notes/letters in scientific journals, 19 refereed chapters in books, and 3 scientific, refereed books.

Tonya Wimmer is a marine mammal biologist with over 10 years of research and conservation experience in Atlantic Canada. She has BSc and MSc degrees in Biology from Dalhousie University. Her MSc thesis examined the distribution and movements of Scotian Shelf Northern Bottlenose Whales. She is the manager of Species Conservation at WWF-Canada where her work primarily focuses on reducing the threat to the endangered North Atlantic Right Whales from entanglement in fishing gear. Tonya also co-coordinates the activities of the Marine Animal Response Society (MARS), a charitable organization that responds to distressed and dead marine animals in Nova Scotia. She coauthored the 2002 COSEWIC status update for the Scotian Shelf population of Northern Bottlenose Whales.