Final

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the North Atlantic Right Whale (*Eubalaena glacialis*) in Canadian Waters

North Atlantic Right Whale

2014

Canada

About the *Species at Risk Act* (SARA) Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003 and one of its purposes is *"to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity."*

What is recovery?

In the context of species at risk conservation, **recovery** is the process by which the decline of an endangered, threatened or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of the species' persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA spell out both the required content and the process for developing recovery strategies published in this series (http://www.sararegistry.gc.ca/approach/act/default_e.cfm).

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

What's next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the Species at Risk Act and recovery initiatives, please consult the SARA Public Registry (http://www.sararegistry.gc.ca/).

Recovery Strategy for the North Atlantic Right Whale (*Eubalaena glacialis*) in Atlantic Canadian Waters

2014

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For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the SAR Public Registry at http://www.registrelep-sararegistry.gc.ca/.

Cover illustration: The cover illustration depicts a female North Atlantic right whale known as Arpeggio, catalogue number 2753. Born in 1997, Arpeggio is a poster child for what right whales do, what they are exposed to, and what tools researchers use to learn about their life history and the threats facing their recovery. She has ranged from the calving ground along the coast of eastern Florida to the Bay of Fundy and has been photographed in each year of her life in several different habitat areas. She was entangled briefly in 1999 at the age of 2½, and survived a hit by a small vessel at the age of eight. She has been exposed to almost every type of research: tagging to learn about dive profiles and response to sound playback, skin sampling to learn about her genetic profile, and ultrasound measurements to assess her health. She has recently had her first calf on the calving grounds in Florida. Illustration credit: Scott Landry, Provincetown Center for Coastal Studies.

Également disponible en français sous le titre
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Preface

The North Atlantic right whale is a marine mammal and is under the responsibility of the federal government. The *Species at Risk Act* (SARA, Section 37) requires the competent minister to prepare recovery strategies for listed extirpated, endangered and threatened species. The North Atlantic right whale was listed as Endangered under SARA in January 2005. The development of this recovery strategy was led by Fisheries and Oceans Canada – Maritimes Region, in cooperation and consultation with many individuals and organizations, as indicated below. The strategy meets SARA requirements in terms of content and process (Sections 39-41).

This Recovery Strategy was first published in June 2009, and subsequently was amended to incorporate changes made to Section 1.9 pertaining to the critical habitat of the population.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Fisheries and Oceans Canada or any other party alone. This strategy provides advice to jurisdictions and organizations that may be involved or wish to become involved in the recovery of the species. In the spirit of the National Accord for the Protection of Species at Risk, the Minister of Fisheries and Oceans invites all responsible jurisdictions and Canadians to join Fisheries and Oceans Canada in supporting and implementing this strategy for the benefit of the North Atlantic right whale and Canadian society as a whole. Fisheries and Oceans Canada will support implementation of this strategy to the extent possible, given available resources and its overall responsibility for species at risk conservation.

The goals, objectives and recovery approaches identified in the strategy are based on the best existing knowledge and are subject to modifications resulting from new information. The Minister of Fisheries and Oceans will report on progress within five years.

This strategy will be complemented by one or more action plans that will provide details on specific recovery measures to be taken to support conservation of the species. The Minister of Fisheries and Oceans will take steps to ensure that, to the extent possible, Canadians interested in or affected by these measures will be consulted.

Responsible Jurisdictions

Under the *Species at Risk Act*, Fisheries and Oceans Canada is the responsible jurisdiction for the North Atlantic right whale.

Authors

The 2009 Recovery Strategy was written by Moira Brown, Derek Fenton, Kent Smedbol, Cathy Merriman, Kimberly Robichaud-LeBlanc and Jerry Conway in cooperation with the Right Whale Recovery Implementation Team (see Recovery Team Members list). The amended sections of the current Recovery Strategy were prepared by Fisheries and Oceans Canada (DFO).

Acknowledgments

DFO acknowledges all participants of the Recovery Team for their dedicated efforts in providing information, expertise and perspectives in the development of this recovery strategy. The National Recovery Plan prepared by the Right Whale Recovery Team for the World Wildlife Fund Canada and the Department of Fisheries and Oceans in 2000 (WWF/DFO 2000) provided the foundation for the development of this document. DFO is grateful to the drafting team (see 'Authors') who further revised the document as per SARA Recovery Strategy content requirements and updated with new information since the publication of the 2000 Plan. Additionally, DFO acknowledges the invaluable input provided by the broader interested public in the consultation process (see Appendix C for a record of consultations).

Strategic Environmental Assessment

A Strategic Environmental Assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The recovery planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts on non-target species or habitats. The results of the SEA are incorporated directly in the strategy itself, but are also summarized below.

This recovery strategy will clearly benefit the environment by promoting the recovery of the North Atlantic right whale. The potential for the strategy to inadvertently lead to adverse effects on other species was considered; however, because the recovery objectives recommend additional research on the species and education and outreach initiatives, the SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects.

Residence

SARA defines residence as: "*a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating*" [SARA S2(1)].

Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SARA public registry: http://www.sararegistry.gc.ca/sar/recovery/residence_e.cfm

Executive Summary

The North Atlantic right whale (*Eubalaena glacialis*) is a large (up to 17 m) whale, generally black in colour with occasional white belly patches and no dorsal fin. Right whales were once common in temperate waters of the Western Atlantic but were seriously depleted by whaling. An accurate population estimate for the species is yet to be calculated. The population of North Atlantic right whales in Atlantic Canadian waters was estimated in 2003 to number about 322 animals; however more recent estimates suggest the current population numbers about 350 animals. North Atlantic right whales are protected and listed under Schedule 1, Part 2 of the *Species at Risk Act* (SARA).

A migratory animal, the North Atlantic right whale travels along the east coast of North America primarily from eastern Florida to the Gulf of St. Lawrence and Newfoundland. The role of Canada in protecting North Atlantic right whales and promoting their recovery is crucial because a very high proportion of the extant population spends all or part of the summer and autumn months in Canadian waters. In particular North Atlantic right whales are observed feeding and socializing in the lower Bay of Fundy and in Roseway Basin on the western Scotian Shelf. The Bay of Fundy has been regularly monitored annually since 1980 by researchers. North Atlantic right whales feed on a variety of organisms but seem to depend most heavily on the copepod *Calanus finmarchicus.*

Since whaling ended the most obvious threats that are potentially depressing the growth rate of the North Atlantic right whale population are strikes by vessels and entanglements in fixed fishing gear. Most of the areas heavily used by right whales in the western North Atlantic are in or near major shipping lanes serving ports in the eastern United States and Canada. There are stewardship measures, such as avoiding areas of whale aggregation, that have helped reduce the threat of vessel strikes in Canadian waters. It has been shown that the types of fishing gear most often implicated in North Atlantic right whale entanglements are the vertical and horizontal lines used in fixed gear fisheries (i.e. gillnets and pot gear). Active emergency response and\or disentanglement programs exist in both Canada and the United States, although the program is broader in scope and funding in the United States. Habitat degradation may also be contributing to the North Atlantic right whale population's failure to recover more rapidly. The migratory and pelagic habits of the species present a significant challenge to fully implement all recovery strategies. Recovery of the North Atlantic right whale will require significant international coordination and cooperation to mitigate the negative impacts of human activities across the species' range.

In February 2007, DFO Science conducted a Recovery Potential Assessment (RPA) for right whales in the western North Atlantic which resulted in Grand Manan Basin in the Bay of Fundy being delineated as critical habitat for the species under SARA. This area has been recognized previously as an important area for North Atlantic right whale aggregation with the designation of the Bay of Fundy Right Whale Conservation Area. Roseway Basin, on the southwestern Scotian Shelf, another important area of North Atlantic right whale aggregation, is also a designated conservation area. Although

insufficient data was available during the RPA to determine whether this area also constitutes critical habitat for the species, initial results from research initiated following the RPA support the conclusion that Roseway Basin meets the criteria as critical habitat for right whales and therefore it has been identified as critical habitat in the recovery strategy. Provisional boundaries have been selected to match the "Area To Be Avoided" (ATBA) designated by the International Maritime Organization (IMO; see section 2.7.1). A schedule of studies is outlined to complete the research activities initiated to refine the boundaries of Roseway Basin critical habitat for right whales.

The lack of firm estimates of historical abundance means that a long-term population target cannot yet be determined. However, current knowledge of the status and trends in this population can be used to develop the interim Recovery Goal: "*To achieve an increasing trend in population abundance over three generations*". To begin to achieve an increasing trend in population abundance of North Atlantic right whales in Canadian waters the following recovery objectives and respective strategies will need to be implemented:

1. Reduce mortality and injury as a result of vessel strikes;
2. Reduce mortality and injury as a result of fishing gear interactions (entanglement and entrapment);
3. Reduce injury and disturbance as a result of vessel presence or exposure to contaminants and other forms of habitat degradation;
4. Monitor population and threats;
5. Increase understanding of life history characteristics, low reproductive rate, habitat and threats to recovery through research;
6. Support and promote collaboration for recovery between government agencies, academia, environmental non-government groups, Aboriginal groups, coastal communities and international agencies and bodies;
7. Develop and implement education and stewardship activities that promote recovery.

There are a number of threat mitigation and research efforts currently underway that contribute to meeting these objectives (see Section 2.7 Actions Completed or Underway). However, there remains a number of gaps in our knowledge about the North Atlantic right whale in Canadian waters including in the areas of biology and ecology, habitat requirements, and additional potential threats. While there has been significant progress in narrowing knowledge gaps in recent years, it is widely accepted that research efforts must continue and increase. The need for consistent resources and dedicated partners to address knowledge gaps, implement recovery strategies and respond to North Atlantic right whale emergencies is important to the success of the program and an ongoing challenge. Following the adoption of this recovery strategy under SARA, action plans for the North Atlantic right whale will be developed. Completion of the evaluation of Roseway Basin critical habitat in order to refine its boundaries will be a high priority to address in an action plan following the finalization of this Recovery Strategy. Addressing potential interactions with fishing gear has also been identified as a high priority for action planning.

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Introduction

Right whales (*Eubalaena* spp), once common in temperate waters of all the world's oceans, were seriously depleted globally by eight centuries of whaling (IWC 1986). Today, the populations in the North Atlantic (*E. glacialis*) and North Pacific (*E. japonica*) ("northern" right whales) are in danger of extinction, while some populations in the southern hemisphere, *E. australis*, ("southern" right whales) are showing signs of a strong recovery (IWC 2001b). Two species of right whale occur in Canadian waters, *E. japonica* in the Pacific and *E. glacialis* in the Atlantic. This recovery strategy will only address North Atlantic right whales, estimated to number 322[1] individuals (COSEWIC 2003).

The North Atlantic right whale (*Eubalaena glacialis*) is a large (up to 17 m) whale, generally black in colour with occasional white belly patches and no dorsal fin. A migratory animal, the North Atlantic right whale travels along the east coast of North America primarily from eastern Florida to the Gulf of St. Lawrence and Newfoundland. The role of Canada in protecting North Atlantic right whales and promoting their recovery is crucial because a very high proportion of the extant population spends all or part of the summer and autumn months in Canadian waters.

North Atlantic right whales are listed as Endangered under Schedule I, Part 2 of SARA, which results in legal protection and mandatory recovery requirements, which are administered by Fisheries and Oceans Canada (DFO). This recovery strategy summarizes the best available information on the biology and status of the North Atlantic right whale, and reflects our current knowledge about this animal and the need for cooperation and coordination in its recovery. The recovery strategy will be accompanied by one or more action plans (produced as a separate document), also a requirement under SARA. Action plans list the measures that are to be taken over the next 5 years to implement the recovery strategy. It is intended that this strategy will provide a mechanism to work toward minimizing threats to North Atlantic right whales both nationally and internationally, and will eventually result in their recovery.

This recovery strategy builds on the substantial efforts by the North Atlantic right whale recovery team, which was established in 1997, sponsored by World Wildlife Fund Canada and DFO, and formed to bring together the various experts and interests involved in the conservation of the species. This resulted in the production of a comprehensive recovery plan (WWF/DFO 2000) that provides a foundation for this document.

[1] Represents number of catalogued North Atlantic right whales thought to be alive in 2003 (COSEWIC 2003). A precise population estimate for the species is yet to be calculated, however, more recent estimates suggest a population abundance of approximately 350 animals (Kraus and Rolland 2007, NMFS 2005).

1. Background

1.1 Status

1.1.1 Canadian

Date of Assessment: May 2003

Common Name (population): North Atlantic Right Whale

Scientific Name: *Eubalaena glacialis*

Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status: Endangered

Reason for Designation: The species, found only in the North Atlantic, was heavily reduced by whaling. The total population currently numbers about 322 animals (about 220-240 mature animals), has been decreasing during the last decade (1990s), and is experiencing high mortality from ship strikes and entanglement in fishing gear. A sophisticated demographic model gives an estimated mean time to extinction of 208 years.

Canadian Occurrence: Atlantic Ocean

COSEWIC Status History: The right whale was considered a single species and designated Endangered in 1980. Status re-examined and confirmed in April 1985 and in April 1990. Split into two species in May 2003 to allow a separate designation of the North Atlantic right whale. North Atlantic right whale was designated Endangered in May 2003. Last assessment based on an updated

1.1.2 Global

Status in the United States (U.S.)

In U.S. waters, the North Atlantic right whale (originally jointly listed with the North Pacific right whale as 'northern' right whale) was first protected in June 1970 by the *Endangered Species Conservation Act,* which was the precursor to the *Endangered Species Act* (ESA). The species was subsequently listed as 'endangered' under the ESA since its passage in 1973. In the same year, the species was designated as endangered and 'depleted' under the *Marine Mammal Protection Act* (MMPA).

Mandated under the ESA, in 1991 the U.S. Department of Commerce published a Recovery Plan for the Northern Right Whale (including both the North Atlantic and North Pacific right whale), which reviewed knowledge about natural history and human

impacts, along with an outline of steps needed to reduce the risks of extinction and enhance the prospects of population recovery (NMFS 1991). The NMFS revised the 1991 plan and developed a separate recovery plan for the North Atlantic right whale population in 2005 (NMFS 2005). Under the ESA and MMPA, the NMFS produces annual stock assessments, which include for each stock the allowable "potential biological removal" (PBR) level. The current PBR for the North Atlantic right whale population is zero whales per year.

Under U.S. law, "critical habitat" of endangered species must be designated and given special protection. Three areas were officially designated in 1994 as "critical habitat" under the ESA for the North Atlantic right whale population: Great South Channel and Cape Cod Bay (both in the southern Gulf of Maine) and the nearshore calving ground off northern Florida and Georgia (Figure 1).

International status

All right whales have been protected from commercial whaling since 1935, and further protected under the International Whaling Commission (IWC) since 1949.

Globally, the right whale was listed as endangered and receives protection under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). For countries that are signatories to the Convention, including Canada, CITES is an international agreement to ensure that trade in products derived from wild animals and plants does not threaten their survival. Right whales were listed as 'endangered' by CITES in 1975 in Appendix 1, which consists of species threatened with extinction; trade of such species is only permitted under exceptional circumstances.

1.2 Distribution

1.2.1 Global range

The known historical range of right whales, based on whaling records, included a large area of the eastern seaboard of North America. This area extended from northern Florida along the coast to the waters of Atlantic Canada (Figure 1), east to southern Greenland, Iceland, and Norway, and south along the European coast to northwestern Africa (IWC 1986, Mead 1986, Mitchell et al. 1986, Reeves and Mitchell 1986).

Since the 1920s, sightings in the eastern North Atlantic have been sporadic (e.g., in the Canaries, Madeira, Spain, Portugal, United Kingdom, Iceland, and Norway), (Brown 1986, Martin and Walker 1997). In the western North Atlantic, right whales once occurred from Florida to Labrador, including the Strait of Belle Isle and Gulf of St. Lawrence (Aguilar 1986, Reeves et al. 1999, Reeves 2001). Prior to the 1930s they were also encountered and hunted during the summer in pelagic waters, particularly near the eastern edge of the Grand Bank and in an area directly east and southeast of Cape Farewell, the southern tip of Greenland (Reeves and Mitchell 1986).

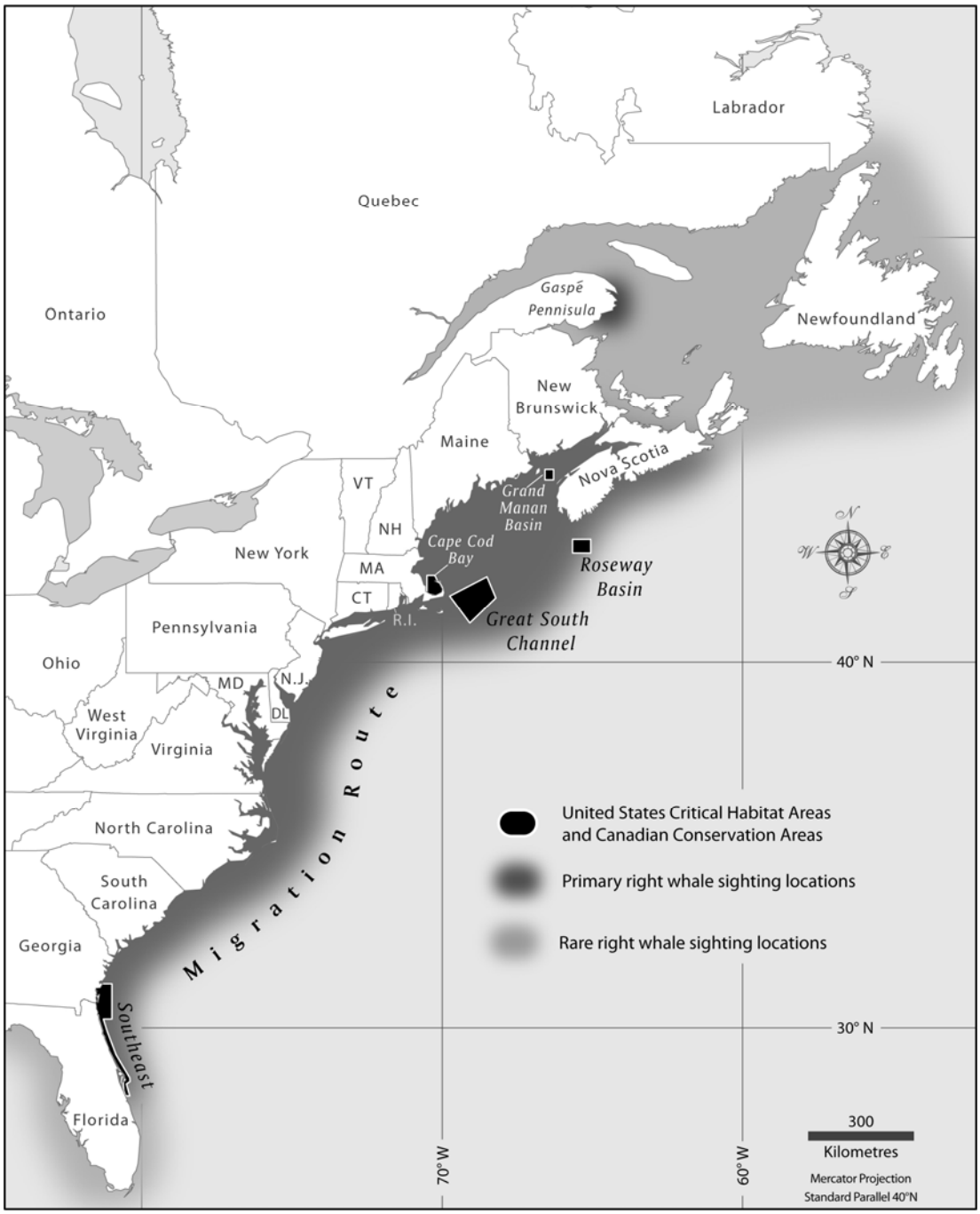

Figure 1. *Western Atlantic range and present day distribution of the North Atlantic right whale. Critical habitat areas in U.S. waters are those areas formally designated under the U.S. Endangered Species Act (Prepared by K. Lagueux, New England Aquarium).*

1.2.2 Canadian range

Two of the five known high-use habitat areas for this species are located in Atlantic Canada (Figures 1 and 2) with the other three located in the U.S. (Figure 1). In the summer and autumn, North Atlantic right whales are observed suckling, feeding, and

socializing in the lower Bay of Fundy between New Brunswick and Nova Scotia, and feeding and socializing in Roseway Basin between Browns and Baccaro Banks on the western Scotian Shelf (Stone et al. 1988, Kraus and Brown 1992, Brown et al. 1995). The Bay of Fundy has been monitored annually since 1980 by researchers from the New England Aquarium (NEAq, Boston, Massachusetts). Monitoring of Roseway Basin has been more sporadic with surveys occurring in 1979-1980, 1985-1993, and 1998-2006 by the NEAq and other research groups.

In addition, there are several other areas of Atlantic Canadian waters where North Atlantic right whales have been seen (Figure 2). For example, North Atlantic right whales have been sighted in deep basins on the eastern Scotian Shelf (Mitchell et al. 1986; T. Cole, personal communication[2]), in the St. Lawrence Estuary near the confluence of the Saguenay River in 1998 (R. Michaud, pers. comm.), near the Mingan Islands off the lower north shore of Quebec in 1994, 1995, and 1998 (R. Sears, pers. comm.), and more than 30 different individuals over a decade near the mouth of the Baie des Chaleurs south of the Gaspé Peninsula in 1995-1998, and 2000-2006 (N. Cadet, J.F. Blouin pers. comm.). A dead North Atlantic right whale was found near the Magdalen Islands in the Gulf of St. Lawrence in 2001 (NEAq unpublished data), and in the same year an entangled North Atlantic right whale was tracked with a satellite-monitored transmitter along the eastern Scotian Shelf into the Gulf of St. Lawrence to the Magdalen Islands and back to the Scotian Shelf, then south into the Gulf of Maine (Provincetown Center for Coastal Studies, unpublished data). Photographed sightings of North Atlantic right whales during the summer months from the Gulf of St. Lawrence, Gaspé Peninsula, and Labrador Basin, (Knowlton et al. 1992) have been matched to individuals in the identification catalogue for the North Atlantic right whale (Hamilton and Martin 1999).

North Atlantic right whales have not been sighted for more than a century in the historical whaling grounds in the Strait of Belle Isle between Labrador and Newfoundland. Here the species' range is believed to have overlapped that of the bowhead whale (Aguilar 1986, Cumbaa 1986). Recent analyses of DNA extracted from bone indicate that, contrary to what was previously believed, a very high proportion of the whales taken by the Basque whalers at Red Bay, Labrador, were bowheads (*Balaena mysticetus*) rather than North Atlantic right whales (Rastogi et al. 2004).

[2] Institutional affiliation for personal communications can be found at end of the References section.

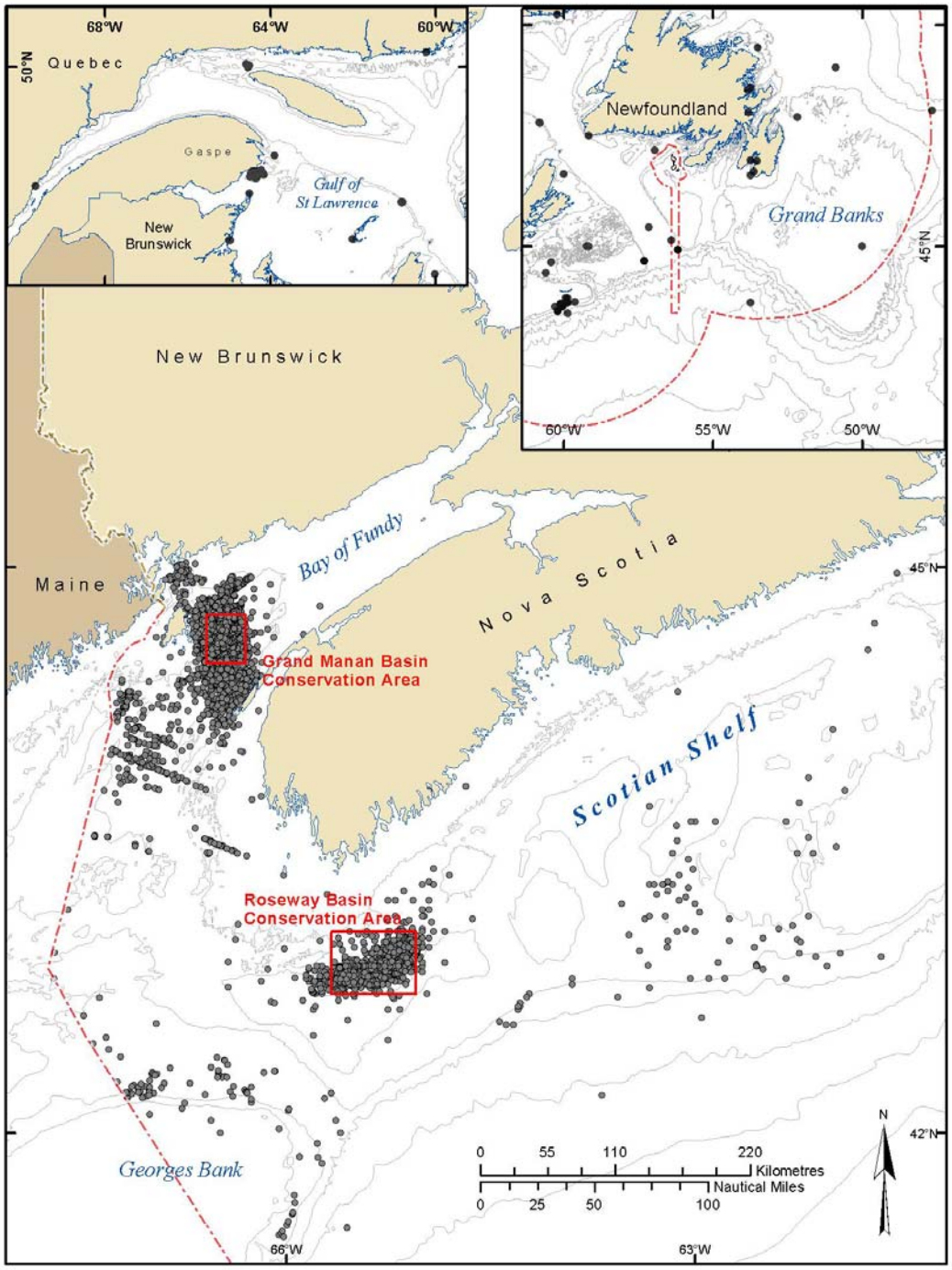

Figure 2. Canadian range of the North Atlantic right whale: 1951-2005. *This map is based on individual North Atlantic right whale sightings from the North Atlantic Right Whale Consortium 1951-2005, the St. Andrews Biological Station whale sightings database 1992-2005 and the DFO Newfoundland Region whale sighting database 1975-2003. Dots indicate North Atlantic right whale sightings (with U.S. waters data removed) and the red dotted lines are the boundaries of the exclusive economic zone of Canada, the United States and St. Pierre and Miquelon (France). (Prepared by Oceans and Coastal Management Division, DFO).*

1.3 Legal protection

North Atlantic right whales are listed under Schedule 1, Part 2 of the *Species at Risk Act* (SARA), and therefore the SARA provisions against the killing, harming, harassing, capturing, taking, possessing, collecting, buying, selling, or trading of individuals or its parts (SARA section 32) and the damage or destruction of its residence (SARA section 33) apply directly to this species. A rationale for not providing a residence description for the North Atlantic right whale has been developed (DFO 2007, Smedbol 2007).

Once identified, prohibitions will also be in place against the destruction of the species' critical habitat (SARA section 58), where critical habitat is defined under section 2 of the Act as *"the habitat necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan".* Section 1.9 will address critical habitat as it relates to North Atlantic right whales in Canadian waters.

In addition to SARA, other federal statutes that offer legal protection for North Atlantic right whales and their habitat in Canada include the 1985 *Fisheries Act* (under Marine Mammal Regulations and a series of habitat protection provisions) administered by the Minister of Fisheries and Oceans. The Marine Mammal Regulations give North Atlantic right whales legal protection from disturbance and deliberate killing, while the habitat protection provisions of the *Fisheries Act* prohibit works or undertakings that would cause the harmful alteration, disruption or destruction of fish habitat, including the habitat of marine animals.

1.4 General biology and description

1.4.1 Name and classification

Class: Mammalia
Order: Cetacea
Family: Balaenidae
Species: *Eubalaena glacialis*

Common species names
English: North Atlantic Right Whale
French: Baleine noire de l'Atlantique Nord or baleine franche

1.4.2 Taxonomic status

A 1998 International Whaling Commission (IWC) workshop recommended using *Eubalaena* (the right whales) as a separate genus. The IWC Scientific Committee, after considering genetic and morphological data, decided at its 2000 annual meeting to accept Rosenbaum et al.'s (2000) analysis and proposed nomenclature. It was agreed to retain the generic name *Eubalaena* for right whales, and to recognize three species,

E. glacialis in the North Atlantic, *E. japonica* in the North Pacific and *E. australis* in the southern hemisphere (IWC 2001a).

The population structure of right whales in the North Atlantic is poorly understood. A right whale workshop hosted by the IWC provisionally divided the North Atlantic (for statistical purposes) into eastern and western sectors and proposed to treat the area off Cape Farewell (60-62ºN, 33-35ºW) separately. However, photographs of identifiable individuals in the western North Atlantic have been matched with photographs of individuals in the Labrador Basin south-southeast of Greenland and off Norway (Knowlton et al. 1992, IWC 2001b). Given what is currently known about right whale movements and distribution, it is perhaps reasonable to continue to view the whales in the eastern and western North Atlantic as separate "stocks" while recognizing that these animals are highly mobile and sometimes move far outside their well-known habitats in the western North Atlantic (Knowlton et al. 1992, Reeves 2001).

1.4.3 Physical description

Right whales are large, relatively rotund whales, with square chins and a generally black colouration with occasional white belly and chin patches and no dorsal fin (Figure 3). They grow to about 17 m in length, with adult females averaging about 1 m larger than adult males (Allen 1908, Andrews 1908). Adult right whales weigh approximately 60-70 metric tones. A blubber layer up to 20 cm thick serves for both energy storage and insulation (Angell 2005). The head is about 25% of the total body length in adults, up to 35% in juveniles. A strongly arched, narrow rostrum and strongly bowed lower jaws are characteristic of the species.

Gray or black roughened patches of skin, called callosities, are found on the rostrum, behind the blowholes, over the eyes, on the corners of the chin, and variably along the lower lips and jaws (Figure 3). The callosity pattern is unique to each right whale and is used by researchers to identify individuals (Crone and Kraus 1990, Hamilton and Martin 1999, Kraus et al. 1986a). Callosities appear light yellow or cream coloured due to infestations of cyamid crustaceans commonly called whale lice. Baleen plates are black or brown, number 205 to 270 on each side, average 2 to 2.8 m in length, and are relatively narrow (up to 18 cm wide) with fine hair-like fringes facing the interior of the mouth. There are no grooves along the throat. The tail flukes are broad, measuring up to 6 m from tip to tip. In the field, when seen along the axis of the animal, the blow is distinctly V-shaped and can reach 7 m in height.

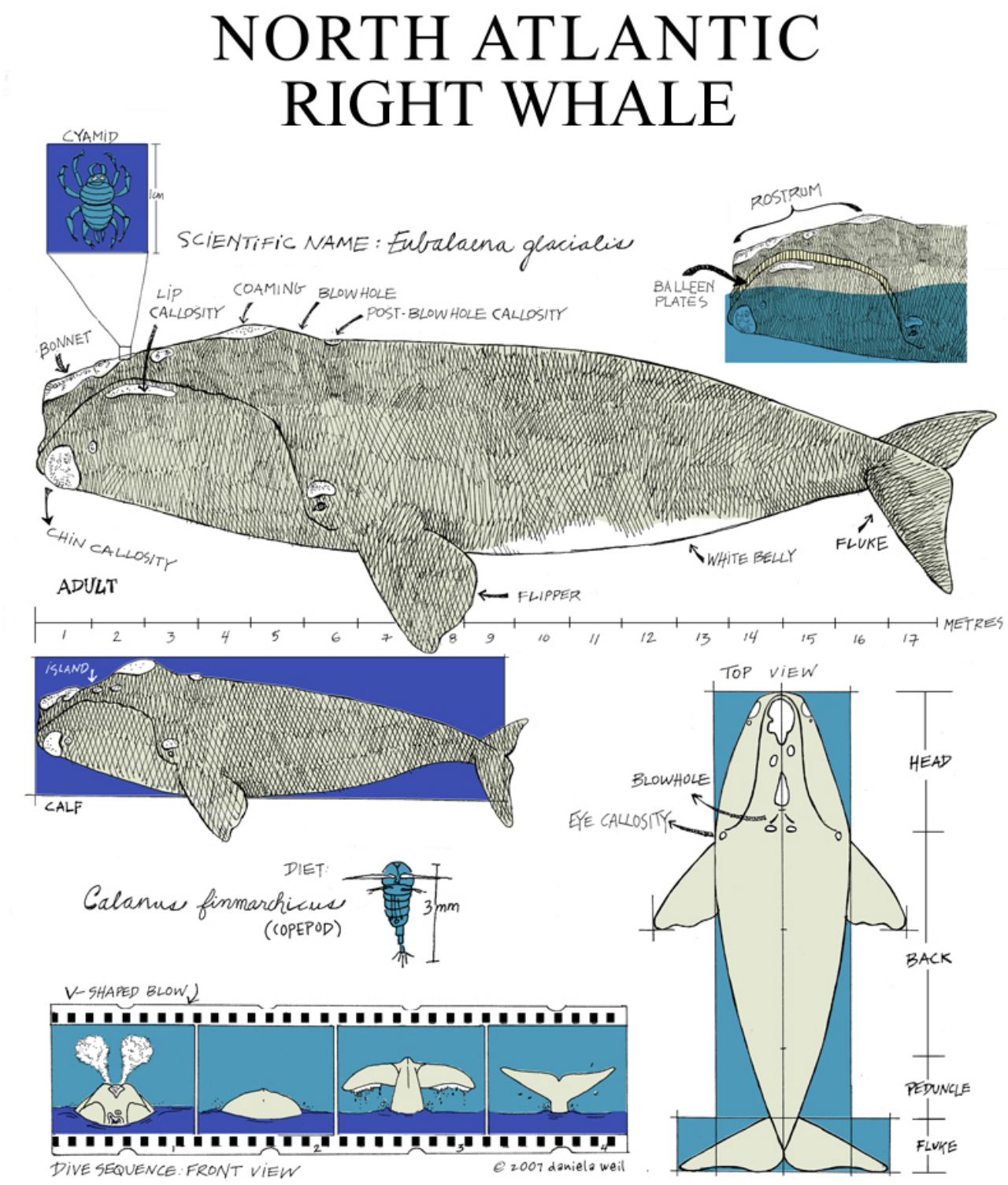

Figure 3. *Schematic depicting an adult and calf North Atlantic right whale and key physical features (Provided by D. Weil).*

1.4.4 Basic biology and ecology

Natural history

While techniques have been developed to determine the age of toothed whales and some baleen whales, none have been demonstrated as effective for North Atlantic right whales (Kraus and Rolland 2007). Back-calculation from first birth records suggests that North Atlantic right whales routinely live longer than three decades. The oldest known North Atlantic right whale was an adult female who lived to be at least 70 years old based on photographic records from 1935 to 1995 (Hamilton et al. 1998). The mean age of female sexual maturity is not known, but the mean age at first parturition is currently about 10 years (Kraus 2002). The youngest known mother gave birth to her first calf at age five (Knowlton et al. 1994). Sexual maturity in males, estimated from a few known paternities, is about 15 years of age (Frasier 2005). Brown et al. (1994) used genital morphology and genetics to infer that the sex ratio in this population is approximately 50/50.

Most calves are born in the coastal waters of northern Florida and Georgia (Kraus et al. 1986b). Since 1980, the number of calves observed each year has varied from a low of one calf in 2000 to a high of 31 calves in 2001; however there is no apparent trend. Between 1980 and 1992, there were 11-12 calves born per year on average (Knowlton et al. 1994). Since some cows with newborn calves are missed during the winter surveys off Georgia and Florida, complete assessment of a year's calf production requires surveys in the northern feeding areas, particularly Cape Cod Bay, the Great South Channel and the Bay of Fundy. At least two females have had calves over a period of 28 years, suggesting that the reproductive lifespan of North Atlantic right whales is at least that long.

The reasons why mothers and calves choose relatively shallow, nearshore habitat in low latitudes for calving grounds are unknown. The advantages provided by this habitat may include avoidance of predation (i.e. killer whales, *Orcinus orca*), relative warmth to conserve energy, reduced exposure to surface turbulence, easier orientation and navigation, and fewer disturbances from boisterous approaches by courting males. This same habitat is apparently not critical to females that are not pregnant, adult males, or most juveniles, as these classes are underrepresented on the calving ground. The advantages of this habitat do not persist beyond the calving season, as North Atlantic right whales are almost never seen off the U.S. east coast south of Cape Hatteras (ca. lat 35ºN) between late spring and late autumn (Winn et al. 1986).

The mating system of North Atlantic right whales is not fully understood, but appears to be shaped in large part by the prolonged spacing of calves (3-5 year intervals). Such spacing means that the effective adult sex ratio is roughly one ovulating female to every four males, leading to significant competition among males for mating opportunities. Courtship is the most energetic behaviour that has been observed with this species. Courtship groups (referred to as “surface-active groups” (SAGs)) may include 40 animals or more, as multiple males try to get close enough to mate with the focal female

(Kraus and Hatch 2001). Males appear to compete for positions next to the female, which are best for taking advantage of each mating opportunity when the female surfaces to breathe (Kraus and Hatch 2001). Based upon the limited data available, it appears that the female may have intercourse frequently during a courtship bout with several different males, and this may result in a substantial degree of sperm competition among competing males. Social factors, such as the need to participate in the activities of "surface-active groups", may also influence an individual's movements.

The seasonal timing and duration of observed courtship activities, from August through October, is puzzling. Calving is first observed in December in the waters off Georgia and Florida and extends through early March. The gestation period for right whales in the North Atlantic is unknown. Best (1994) estimated a 12 month gestation period for southern right whales based on whaling data. Although the seasonal timing of the observed courtship for North Atlantic right whales is not consistent with this estimate, it is possible that courtship in the Bay of Fundy is merely "foreplay," and that conception occurs elsewhere during December. However, observed mating behaviour is indicative of strong competition among males, and participation in SAGs is likely expensive energetically. Thus an alternative hypothesis for this "foreplay" behaviour is that individuals require practice to develop the ability to compete successfully. The resolution of these questions will require better knowledge about the wintering habitats of North Atlantic right whales, and improved methods for evaluating pregnancy in North Atlantic right whales.

Migration and movements

There are five known seasonal, high use areas for North Atlantic right whales. Winn et al. (1986) proposed a six-phase model to explain the seasonal north-south movements of right whales in the western North Atlantic. Most adult females give birth in coastal waters of the southeastern U.S. between Brunswick, Georgia, and Cape Canaveral, Florida, during the winter months (Kraus et al. 1986b). Males and non-calving females are rarely seen in that area, and their whereabouts during the winter remain largely unknown (Kraus et al. 1988). They may be scattered widely along the eastern U.S. coast to at least as far north as Cape Cod Bay (Winn et al. 1986) and the central Gulf of Maine (Northeast Fisheries Science Center unpublished data). There are records of adult and juvenile North Atlantic right whales of both sexes in Cape Cod Bay during the winter and spring, but the number of animals observed annually accounts for less than 30% of the known population (Hamilton and Mayo 1990).

There is a northward migration in the late winter and early spring from the calving ground, with some mother calf pairs moving along the shore. In the spring, aggregations of North Atlantic right whales are observed feeding and socializing in the Great South Channel east of Cape Cod, and in Cape Cod and Massachusetts Bays (Winn et al. 1986, Hamilton and Mayo 1990, Kenney et al. 1995). Directed movements are made in June and July to the feeding grounds in the lower Bay of Fundy and on the western Scotian Shelf where a very high proportion of the known population in seen in at least August and September (Winn et al. 1986). From October, a steady southward

migration occurs, with some animals passing through the Gulf of Maine and off Cape Cod (Winn et al. 1986). Recent data have expanded our understanding of the migration and movement patterns of North Atlantic right whales. For example, sightings of North Atlantic right whales in the Bay of Fundy (Laurie Murison, pers. comm.) and in the southeastern Gulf of St. Lawrence (Jack Lawson, pers. comm.) have been reported into late December as have recordings of their vocalizations on Roseway Basin (Mellinger et al. 2007). Summer and autumn sightings of North Atlantic right whales along the Gaspe Peninsula are indicative of transits between the known habitat areas in Atlantic Canada and the Gulf of S. Lawrence (Canadian Whale Institute and NEAq unpublished data).

1.4.5 Habitat requirements[3]

The North Atlantic right whale is primarily found in coastal and shelf waters. The habitat needs of right whales can be inferred from the seasonal distribution of the population and the types of activities observed in the areas that the animals frequent. Judging by the evidence of segregation among the various classes of whales, habitat requirements appear to differ considerably, depending on a whale's age, sex, and reproductive status (Brown 1994).

Virtually the entire population moves north for the summer; however since nothing is known about how right whales navigate, it is difficult to judge the importance of oceanographic or topographic features along the migratory corridor(s). Winn et al. (1986) found that calf sightings, even in the higher latitudes, were significantly closer to shore than non-calf sightings. The advantages of a near shore migration would, presumably, diminish by late autumn, when most first-year calves are probably about to be weaned (Hamilton et al. 1995). Opportunities to forage en route might also influence the course taken from one destination to the next.

Defining habitat requirements on the feeding grounds is more straightforward, at least conceptually. Several investigators have attempted to define critical threshold densities of prey necessary for efficient feeding by right whales (see feeding behaviour below). It is assumed that the distribution and movements of right whales during much of the year are driven primarily by the distribution of the large zooplankton that constitutes their prey.

Winn et al. (1986) attempted to define preferred habitat by comparing the distribution of sightings (effort corrected) and behaviour (feeding and socializing) with various environmental factors (water depth, sea surface temperature, and sea floor relief). Their overall conclusions were that right whales preferred water 100 to 150 m deep, usually but not always, over steep bottom slopes. Preferred surface temperatures were mainly in the range of 8 to 15ºC. Gaskin (1987) hypothesized that right whales find preferred feeding conditions in frontal zones between well-mixed and stratified water masses (Murison 1986). Right whales are rarely seen in areas where the sea surface temperature is higher than 18ºC (Kraus et al. 1993).

[3] Unless otherwise specified, where used in document here on in, the term 'right whale' will serve as a shortened version of the North Atlantic right whale.

In the Bay of Fundy, right whales are found mainly in the upper Grand Manan Basin, in waters 90 to 240 metres deep, with surface temperatures of 11 to 14.5ºC and weak thermoclines (Murison and Gaskin 1989, Gaskin 1991). However, it would appear that depth and temperature features are, at best, only proxies for other more directly relevant factors. The driving force is more likely the formation and maintenance of dense concentrations of calanoid copepods, which are, in turn, governed by physical features and processes, such as frontal boundaries, vertical stability and stratification in the water column, and bottom topography (Woodley and Gaskin 1996). When right whales first arrive in the Bay of Fundy in early summer, their distribution tends to be dynamic, with animals often occurring in shallow water close to shore. Similar spreading out occurs in the autumn, when they are sometimes seen in very shallow areas (e.g., around Campobello Island, the ledges south of Grand Manan). These trends are consistent with the lack of dense copepod patches in the Grand Manan Basin, which develop through the summer to a peak in late autumn and then decline (Murison 1986). Outside the Bay of Fundy, satellite-monitored right whales have shown an affinity for edges of banks and basins, upwellings, and thermal fronts.

1.4.6 Feeding behaviour

Right whales swim through the water with their mouths open, filtering zooplankton through their baleen. Baleen is a series of keratinous plates that hang down from the whales' upper jaw. Because of the morphology of their baleen, and the need to swim slowly to efficiently push large quantities of water through their baleen, right whales are limited to a feeding on a narrow range of zooplankton species (Baumgartner et al. 2007). Right whales locate aggregations of prey at the surface (skim feeding) or at depth (down to at least 200 metres). In the Bay of Fundy, right whales sometimes swim near to the bottom as evidenced by the fact that they surface with mud on their heads. Right whales in the Bay of Fundy, tracked with timed depth recorders, were recorded on feeding dives to depths of 80-175 metres and lasting for 5 to 14 minutes (Baumgartner and Mate 2003).

Right whales in the western North Atlantic feed on a variety of organisms but seem to depend most heavily on the later oil-rich developmental stages (C-IV and C-V, and adults) of the copepod *Calanus finmarchicus* (Murison and Gaskin 1989, Mayo and Marx 1990, Kenney and Wishner 1995, Baumgartner et al. 2003a, Michaud and Taggart 2007). This dependence is evidenced by the copepod hard parts found in faecal material (Kraus and Prescott 1982, Murison 1986, Kraus and Stone 1995) and by the high density of copepods found in the immediate vicinity, or exactly on the paths, of feeding right whales (Murison and Gaskin 1989, Mayo and Marx 1990). As well, evidence is provided by the fact that spring, summer, and autumn aggregations of right whales occur primarily in areas with high densities of these copepods (Kenney et al. 1986, 1995, Michaud and Taggart 2007, Wishner et al. 1988).

Copepods form dense concentrations both vertically and horizontally where tides, winds, or prevailing currents form convergences or where water parcels of different

temperature, salinity, and density meet to form fronts (Wishner et al. 1988, Kenney and Wishner 1995). Major changes have been observed in the spring and summer distribution of right whales over the last 20 years, suggesting that they respond to changes in prey density. For example, they appeared to favor of the Bay of Fundy over Roseway Basin between 1993 and 1997 (NEAq, unpublished data) and no right whales were found during surveys of the Great South Channel in 1992 (Kenney 2001).

Zooplankton organisms are not homogeneously distributed, but instead usually occur in "patches" in the water column. When sampling in the discrete layers targeted by whales in the Bay of Fundy, Baumgartner and Mate (2003) and Baumgartner et al. (2003b) found copepod abundances that were several orders of magnitude above background levels. The spatial variability in their occurrence was associated with a layer of mixing at the bottom and their depth of dive suggested that they are targeting dense concentrations where conditions help to form discrete, vertically compressed layers of copepods. Concentration may be further enhanced as zooplankton seek preferred intensities of light or other physical factors during diurnal vertical migrations. The mechanisms underlying the formation and maintenance of zooplankton patches are not well understood and are an active area of research both in the right whale research community and in the broader field of biological oceanography.

Right whales are, therefore, highly dependent upon a narrow range of prey, which occur in highly variable and spatially unpredictable patches in the Atlantic ecosystem. The four known northern feeding habitats apparently have conditions that are conducive to the creation of highly concentrated patches of copepods. There is, however, substantial inter-annual variability in copepod production, and thus in right whale abundance, in each of these areas (Brown et al. 2001, Kenney 2001). Right whales may adapted to this unpredictability with a large caloric buffer in the form of blubber (Moore et al. 2001) and an ability to travel long distances in relatively short periods of time (Mate et al. 1997, Slay and Kraus 1999, Kraus 2002, Baumgartner and Mate, 2005).

1.5 Biological limiting factors

1.5.1 Life history strategy

Right whales are typical of species that exhibit long life spans, mature relatively late and produce fewer, larger young. These characteristics result in relatively long generation times. Offspring are typically relatively large and develop slowly, requiring a fair degree of parental investment. Such a life history strategy allows the population to endure periods of low reproductive output. However, long generation times and low annual reproductive rates may leave the species susceptible to increases in mortality (*e.g.* human induced). Over longer periods these species are prone to extinction if mortality remains high. Population recovery can require long periods (on the order of decades) due to the low reproductive rates.

1.5.2 Low genetic diversity

Reproductive success in North Atlantic right whale may be impaired by low genetic diversity in the population. The ongoing genetic analyses of the right whale have shown that this species has among the lowest levels of genetic diversity identified in a large mammal at all markers tested to date, including: minisatellite markers (Schaeff et al. 1997); mitochondrial DNA sequences (Malik et al. 2000); and microsatellite markers (Waldick et al. 2002). These findings have led to the hypothesis that the low level of genetic variability may be at least partially responsible for the reduced reproductive performance observed in this species. Therefore, because this species has such low levels of genetic variability there is an increased probability that mating pairs will have similar genetic profiles, which could subsequently result in a high rate of foetal loss and a reduced reproductive performance. Although conservation actions could not likely be implemented to mitigate the negative impacts of genetic characteristics on reproduction, this information will provide an estimate of the degree to which reproductive success and species recovery are limited by intrinsic factors.

Analyses of the genetic characteristics of the extant population did not detect any evidence of a genetic bottleneck (Waldick et al. 2002). These tests are only sensitive to recent events and suggest that a genetic bottleneck has not occurred since approximately the 1800s. Additionally, genetic analyses of historic specimens from the 1500s suggest that the impact of Basque whaling on the North Atlantic right whale was much less than has previously been assumed, and that small population size may be a long-term characteristic of this species (Rastogi et al. 2004, Frasier et al. 2007). In light of these recent data, suggesting that this species had a small population size *prior* to whaling, the idea of nutritional limitations becomes more feasible.

One hypothesis is that the last ice age reduced this population to a relatively small size, and additionally altered the environment in such a way that the western North Atlantic could only support a small population. Under this scenario, nutritional factors, as well as genetic factors associated with long-term small population sizes, would be expected to influence present-day population trends. Although the hypothesis of nutritional limitations (i.e. reduced availability of right whales' copepod prey) remains to be tested, there is evidence that genetic characteristics are influencing reproductive success as would be expected under this scenario (Frasier et al. 2007).

1.5.3 Low reproductive rates

The reduced reproductive performance of the right whale is recognized as one of the primary factors limiting the species' recovery. Both short-term and long-term factors may affect reproductive rates (Kraus et al. 2007), and may have different implications for long-term recovery.

In a recent analysis of calving intervals between 1982 and 2006, Kraus et al. (2007) observed significant variation in the amount of time between births by individual females. The short-term effects of reduced reproduction include an increase in the average inter-birth interval from approximately 3.5 years in the 1980s to approximately 6

years in the 1990s (Kraus et al. 2001), although since 2001 this average appears to be returning to approximately 3 years for some of the adult females (Kraus et al. 2007).

The long-term reproductive performance of this species is lower than expected, as is demonstrated in the lower number of calves born per year than would be expected given the population parameters. This productivity deficit can be illustrated with a simple calculation. In 2005 the US National Marine Fisheries Service (NMFS) estimated population abundance to range from 300 to 350 individuals (NMFS 2005). Sex ratio in this population is approximately 50:50 (Brown et al. 1994), and it is estimated that 60% of the females are adults (Hamilton et al. 1998). Application of these ratios to the population abundance results in an estimate of approximately 90-105 adult females in any given year. Therefore, since females are capable of giving birth once every 3 years (Knowlton et al. 1994, Kraus et al. 2001), it is expected that approximately 30-35 calves should be born per year, instead of the average of 11 in the 1980s and 1990s (Kraus et al. 2001) and 23 between 2001 and 2005 (Kraus et al. 2007) It appears that a high percentage of adult females have either never given birth or have had only one offspring.

1.6 Economic, cultural and ecological significance

The right whale is an important resource for several coastal communities in Atlantic Canada (see whale watching below). The right whale is a large, rare species that is becoming better known amongst the general public. There has been some media coverage about conservation issues and actions in Canada and the United States. The species almost certainly has substantial non-consumptive value to Canadian society because members of the public want to preserve the species for future generations (legacy value) or just derive value from knowing the species exists even though they will never personally see or ‘use’ the species (existence value).

1.6.1 Whale watching

Whale watching is an important part of the growing ecotourism sector along the shores of New Brunswick and Nova Scotia, particularly in the West Isles and Grand Manan, New Brunswick and Digby Neck, Long Island and Brier Island, Nova Scotia areas. Right whales are one of four large whale species commonly observed in the Bay of Fundy. The industry in New Brunswick and Nova Scotia experienced rapid growth in the mid- to late 1990s. In 1998, there were 140,000 individual whale-watching trips in all of New Brunswick and Nova Scotia with $5.12M in direct expenditures (Hoyt 2000). Whale watching is also an important economic industry in Québec with occasional sighting of North Atlantic right whales. The influence of right whale abundance on the overall viability of whale watching tour operators is not currently known as other whale species are also seen. However, the public’s awareness and sensitivity toward right whale issues is enhanced through the educational component of whale watch excursions.

1.6.2 Aboriginal

Right whales were found historically, and continue to be seen in the areas of Mi'kmaq, Passamaquoddy, and Maliseet Aboriginal communities. Harvesting of marine mammals is a tradition of Aboriginal communities in many parts of North America that reaches back several thousand years. Historical and present-day uses and values of the North Atlantic right whale to Aboriginal communities are not known but there are currently no harvests for food, social and ceremonial purposes.

1.6.3 Ecological

Right whales are of great biological and ecological interest since they are one of the few marine mammals of this size that feed so low on the trophic chain (Gaskin 1991). Given this characteristic, right whales may be a good representative of ecosystem health, and a potential useful tool for monitoring the environment, as the species is known to show sensitivity to subtle environmental changes.

The reproductive biology of right whales also makes them an interesting species. Data suggest that right whales represent the most extreme case of sperm competition in the animal kingdom. Understanding how this mating system impacts population dynamics (including the limits it places on growth and reproduction rates) may not only aid our understanding of this species, but could also aid our understanding of reproduction and reproductive biology in general.

This species may also be important for understanding small populations. The long-term data set and extensive genetic data combine to make this animal one of the most well-documented wild species. As such, it has the potential to be a model for understanding the biology of small populations.

1.7 Population size, structure and trends

The population of right whales in the western North Atlantic was estimated in the COSEWIC report (2003) to number about 322 animals. The COSEWIC report did not present the methods used to estimate population size, however the estimate represents the number of catalogued right whales thought to be alive in 2003. Kraus and Rolland (2007) suggest that currently, there are no reliable estimates of right whale population size beyond stating that about 350 animals remain. In terms of trends, the population appeared to have been declining in the 1990s (Caswell et al. 1999, Fujiwara and Caswell 2001, Fujiwara 2002, Caswell and Fujiwara 2004), but only data through 1998 were used in those analyses.

The North Atlantic right whale population is currently assumed to represent one interbreeding population; however this topic has yet to be adequately addressed. It is recognized that there are great differences in the habitat use patterns of different individuals (Brown et al. 2001), and that the population shows significant signs of structuring or fidelity in relation to nursery use by mothers (Malik et al. 1999). However

it is not known if these patterns also result in the population being structured into two or more subpopulations separated by some degree of reproductive isolation. Identifying cryptic population structure such as this represents one of the primary concerns in conservation biology because conservation actions often fail in situations where structuring exists but is undetected or unaccounted for (Taylor and Dizon 1999). Testing for structure will identify if this species can be managed as one interbreeding population, or if it represents more than one continuous gene pool, with each sub-population requiring different management considerations. Additionally, these data will reveal previously hidden information on social structure, reproductive biology, and habitat use patterns. The tools necessary for addressing this issue (genetic profiles at a large number of variable loci) are now available, and this work is currently underway.

The North Atlantic right whale population was probably even smaller in the past than it is today (Reeves et al. 1992, Reeves 2001). Malik et al. (1999) found only five matrilines represented in the mitochondrial DNA (mtDNA) from over 200 animals sampled in the western North Atlantic population. Since mtDNA is inherited only from the mother, this suggests that the population went through a very small "bottleneck" at some time in the recent past. It is important to recognize, however, that each mtDNA haplotype could have been represented by more than one female and therefore the study by Malik et al. (1999) does not necessarily imply that only five female North Atlantic right whales existed at some point in the past.

Based on analyses of stranding, entanglement, and photographic data, Kraus (1990) and Kenney and Kraus (1993) estimated that mortality ranged between 5% and 18% during the first three years of life. Moore et al. (2007) determined that calves and juveniles are at significantly greater risk of dying than adults in a given year, though their analysis of all known mortality events shows no particular distribution among age classes or between sexes. Adult mortality rates are very low, probably less than 1% annually, although population modelling studies (Fujiwara and Caswell 2001, Caswell and Fujiwara 2004) indicate that adult female mortality rates are substantially higher, and are the major contribution to the lack of recovery (Fujiwara and Caswell 2001, Kraus 2002).

The North Atlantic right whale population has been subject to significant anthropogenic mortality (Knowlton and Kraus 2001) and has experienced a significant decline in reproductive rates during the 1990s (Kraus et al. 2001**,** Caswell and Fujiwara 2004). In the period from 1980 to 1992, annual estimates of population size back-calculated from data on calving and mortality indicated a steady increase from 255 in 1986 to 295 in 1992, implying a mean net annual growth rate of 2.5% (Knowlton et al. 1994). Fujiwara and Caswell (2001) however calculated the asymptotic population growth rates from 1980 to 1995 and found that the rate had, in fact, declined from 1980 to 1995. Those authors suggested that if the 1995 growth rate were maintained, the population would become extinct in perhaps as little as 100, and on average about 200 years. This latter analysis is currently thought to best represent the population growth rate trend for that time period (Kraus et al. 2005). The eastern North Atlantic population probably numbers

in the low tens of animals, at most, and is certainly too small to offer any hope of a “rescue effect” on the western population.

1.8 Threats

Since whaling ended in the 1930s the most obvious threats that are potentially depressing the growth rate of the North Atlantic right whale population are strikes by vessels and entanglements in fixed fishing gear. Of 75 reliably documented right whale deaths between 1970 and January 2007, eight (~11%) were traced to entanglements in fishing gear, 28 (37%) were traced to collisions with vessels, 21 (28%) were attributed to "unknown causes" and 18 (24%) to "neonatal mortality" (Knowlton and Kraus 2001 and NEAq unpublished data). Twenty-one of the 28 known ship strikes (75%) have occurred over the period 1991 through January 2007 and represent 50% of the known right whale mortalities for this period. The actual total number of deaths resulting from human activities is unknown; however, it is almost certainly higher than the observed number because not all carcasses of right whales are found. For example, carcasses of right whales that die as a result of entanglements in fishing gear may be more likely to sink at sea because of the decreased health of the animals and subsequent loss of blubber mass and thus it has been suggest that up to two-thirds of human-caused right whale deaths may go undetected (Moore et al. 2007).

The only "natural" mortality currently observed is neonatal mortality, though it should be presumed that natural deaths from old age occur as well. The category of “unknown” deaths includes those animals for which the carcass was not retrieved, the carcass was too decomposed to identify a causal factor, or no obvious factor was found despite a detailed necropsy.

The mortality from vessel strikes and entanglements would be particularly significant if it was biased toward females. Given that females accompanied by calves are usually observed in coastal waters where fishing gear and ships are more common, it is plausible that adult females would be more vulnerable to the threats of ship strike and entanglement. Overall, known deaths in the last five years reflect a female bias (NEAq unpublished data).

1.8.1 Historical threat – whaling

Right whales played a large role in the development of the whaling industry in eastern North America. The name of the right whale may have come from whalers who thought that it was the "right" whale to kill from an economic perspective, although the exact origin of the common name is unknown. They were easy to approach, floated after death and provided large amounts of products such as oil and baleen. As a consequence, the population was reduced to very low levels and was commercially extinct in the 19th century. The population was legally protected from commercial whaling in the 1930s.

As early as the 14th century, Basque ships were whaling off the waters of Atlantic Canada and are thought to have targeted species such as right whales. Whaling in the United States was the centre of the world whaling industry during the 18th and 19th centuries. In the western North Atlantic, right whales were hunted in coastal waters from Florida to Labrador, including the Strait of Belle Isle and Gulf of St. Lawrence (Aguilar 1986, Reeves et al. 1999, Reeves 2001). They were also encountered and hunted during the summer in pelagic waters, particularly near the eastern edge of the Grand Bank and in an area directly east and southeast of Cape Farewell, the southern tip of Greenland (Reeves and Mitchell 1986). There is only limited evidence of historical whaling for right whales the present-day high-use areas; the Bay of Fundy (Reeves and Barto 1985), the Scotian Shelf (Mitchell et al. 1986), and the Great South Channel (Reeves and Mitchell 1986, Reeves et al. 1999).

It is interesting to note that no right whales have been reported for more than a century in the supposed historical Basque whaling grounds in the Strait of Belle Isle between Labrador and Newfoundland, where the species' range is believed to have overlapped that of the bowhead whale (Aguilar 1986, Cumbaa 1986). It has generally been assumed that the balaenids hunted in summer in this region were right whales, while those hunted from late autumn through spring were bowheads (Tuck and Grenier 1981, Cumbaa 1986, Reeves and Mitchell 1986). Recent analyses of DNA extracted from bone material indicate that a very high proportion of the whales taken by the Basque whalers at Red Bay, Labrador, were bowheads rather than right whales (Rastogi et al. 2004 and (Frasier et al. 2007). These results contradict earlier views that Basque whalers harvested equal proportions of right whales and bowhead whales in that area, in turn suggesting that the right whale population has been relatively low since before commercial hunting (Frasier et al. 2007).

1.8.2 Vessel strikes

The importance of vessel collisions as the leading cause of mortality for right whales has been recognized since the 1970s (Reeves et al. 1978, Kraus 1990, Kraus et al. 2005, Moore et al. 2007). Since 1970, there have been 75 carcasses reported, at least 28 of which have died as a result of a ship strike (Knowlton and Brown 2007). Twenty-one of the 28 ship strikes (75%) have occurred over the period 1991 through January 2007 and represent 50% of the total right whale mortalities for this period. In addition to the outright mortality, about seven per cent of the living population was seen to have "major wounds" on the back or tail peduncle caused by propellers. Thus the actual total number of deaths resulting from vessel strikes is unknown; however, it is almost certainly higher than the observed number because not all injured right whales are found and the poor condition of some carcasses prevents conclusive determination of the cause of death (Moore et al. 2007). Moreover, the morbidity, lowered productivity and decreased longevity of animals with "nonfatal" or "possibly fatal" injuries (e.g., propeller cuts, deep gashes, severed flukes) must be taken into account when evaluating the total impact of vessel collisions. Seven of the 28 (25%) fatalities traced to vessel strikes are known to have taken place in Canadian waters between 1987 and 2006.

The mechanisms involved in a whale's ability to detect and take evasive action to prevent being struck by a vessel are poorly understood. Evidence suggests that the hearing range of right whales encompasses frequencies produced by vessels (Knowlton and Brown 2007). However, it may not be too surprising that right whales do not always take successful evasive action when vessels approach them, since the sound produced by most vessels propagates toward the rear and sides of the vessel; the area forward of the bow may be the quietest location. The effect of noise masking by meteorological conditions (wind, waves and precipitation) is not known. It has also been argued that for an animal with such a long lifespan, there has been no opportunity to evolve a response to vessels, since vessel traffic is a relatively new addition to their habitat, and vessel speeds have increased in the past several decades.

Most of the areas heavily used by right whales in the western North Atlantic are in or near major shipping lanes serving ports in the eastern United States and Canada (Knowlton and Kraus 2001). There are, however, stewardship measures at our disposal that will help reduce the threat of vessel strikes in Canadian waters. For example, researchers used evidence from extensive survey work in the Bay of Fundy and limited radio tracking to show that right whales were found most frequently and in highest concentrations in the deepest part of the Bay of Fundy, which placed them in or near the Bay of Fundy Traffic Separation Scheme (Knowlton and Brown 2007, Mate et al. 1997, Vanderlaan et al. 2008). As the whales are highly mobile, their wanderings frequently take them across other shipping routes, including Roseway Basin on the western Scotian Shelf and ones east of Halifax (Mate et al. 1997). The Bay of Fundy Traffic Separation scheme was amended to reduce the relative probability of vessel/right whale interaction (e.g., see Knowlton and Brown 2007). Vanderlaan et al. (2008) estimate that the probability of interaction in the outbound traffic lane has been reduced by an average of 90%.

Recent investigations seek to understand the influence of both vessel size and vessel speed on injury or mortality of right whales. It is known that both small and large vessels can cause death and life-threatening injury to right whales, such as the observed morbid condition of a whale that had been struck by a 12.8 meter long recreational vessel (Knowlton and Brown 2007). As more strikes are documented where the vessel speed is known, findings suggest that vessels traveling at less than 13 knots (26 km/h) may provide right whales with a greater likelihood of avoiding serious injury or death (Knowlton and Brown 2007). Vanderlaan and Taggart (2007) analyzed right whale vessel strike data and concluded that at vessel speeds above 15 knots (28 km/h), lethality to whales approaches 100%. Conversely they found that for whale strikes by vessels travelling at less than 11.8 knots (22 km/h), lethality dropped below 50%.

1.8.3 Entanglement in fishing gear

Entanglement and entrapment of right whales (and other cetaceans) in fixed fishing gear (and other lines in the water) has been known as a hazard for decades. For example, as early as 1909, a young right whale became entangled in a fish-trap in

Provincetown Harbor (Massachusetts), allowing local fishermen to kill it with a bomb-lance (Allen 1916). Reports in the 1970s of whales entangled in netting and lobster lines, and trapped in herring weirs, were regarded as "exceptional" events by Reeves et al. (1978). But the more rigorous evaluations since then by Kraus (1990), Kenney and Kraus (1993), and Knowlton and Kraus (2001) have shown that interactions with fishing gear are considered a major source of serious injury and mortality and an important factor in slowing the right whale population's recovery (Kraus et al. 2005).

The most recent analysis of scarring showed that more than 75% of right whales have scars indicative of an entanglement at some time in their lives and that the rate of scar accumulation increased in the 1990s (Knowlton et al. 2005). While no sex bias was apparent, there is an age bias: juvenile right whales experienced a disproportionately higher number of entanglements than adults (Knowlton et al. 2005). The attribution of entanglements to a particular geographical location or gear type is difficult to determine because the whales are highly mobile and the entangling gear retrieved is often unmarked. However, it has been shown that the types of fishing gear most often implicated in right whale entanglements are the vertical and horizontal lines used in fixed gear fisheries (i.e. gillnets and pot gear) in Canadian and U.S waters (Johnson et al. 2005). There is little information regarding the risk of entanglement in gear associated with aquaculture operations, although there is one known instance of an entanglement that occurred in 1990 (DFO and NMFS unpublished data).

Since 1988, at least two right whale mortalities from entanglement can be attributed to fishing gear traced to Canadian fishing operations (Knowlton and Kraus 2001, NEAq unpublished data). The actual total number of deaths resulting from entanglements range-wide is unknown. However, it is almost certainly higher than the observed number in Canadian and US waters as indicated by the analysis of entanglement data from 1980 through 1999 that documented eight right whales, that were last seen alive but with potentially fatal entanglements, that are presumed dead (Knowlton and Kraus 2001).

In Atlantic Canadian waters, researchers are using right whale sighting data and logbook data from the fixed gear fisheries to determine where there is a seasonal overlap between the whales and fishing operations (Taggart et al. 2005). In the past, most fishing activity was thought to occur at a time of year when right whales were not present (WWF/DFO 2000). However, due to more comprehensive sighting data, examination of fishing gear retrieved from entangled right whales, and the emergence of new fixed gear fisheries that are carried out in the summer and autumn, it is clear that there is a greater risk for right whale entanglement in Canadian waters than was previously thought.

Disentanglement efforts in Canada and the United States have resulted in the freeing of some right whales and the release of a few entrapped in herring weirs (NEAq, PCCS unpublished data). Disentanglement of free-swimming right whales is notoriously difficult, often unsuccessful and does not guarantee survival of the whale in question;

however, these efforts should continue even when changes in fishing practices are implemented that are successful in eliminating severe entanglements.

1.8.4 Disturbance and habitat reduction or degradation

General references have been made to the possibility that habitat degradation is contributing to the North Atlantic right whale population's failure to recover more rapidly (Reeves et al. 1978, Kraus 1985, Gaskin 1987, Kraus et al. 2005, Kraus and Rolland 2007). The concept of habitat quality reduction or degradation includes a host of short- and long-term phenomena from exposure to contaminants from marine and land-based activities, as well as exposure to excessive noise, and to changes in the food supply as a result of human activities.

Two points must be made when discussing habitat degradation in the context of right whale recovery strategies. First, it cannot be assumed that right whales simply relocate once a threshold of disturbance has been reached in a part of their range. The cost of such relocation is likely to take the form of reduced reproductive success or increased mortality, or both. Second, the effects of various types of degradation are likely to be cumulative or synergistic, or both. While cumulative and synergistic effects are potentially important, (Bunch and Reeves 1992, Pearce and Wallace 1995, Mangel et al. 1996), it is extremely difficult or impossible to document and describe these effects using empirical data.

Contaminants

As specialists that prey only on relatively small zooplankton that are low in the food web, right whales are less prone than most other baleen whales to accumulate large body burdens of organic contaminants (Woodley et al. 1991). Moreover, baleen whales generally have lower contaminant concentrations in their tissues than the toothed whales (O'Shea and Brownell 1994). If contaminants are affecting the survival or reproductive success of any baleen whale population, the effects have yet to be detected and described. It is important to emphasize that this does not mean there is no effect. It is extremely difficult to prove a causal link of this kind in a large, rare, wild mammal, for which standard experimental or epidemiological approaches are impossible. Even if there were no direct adverse effects on right whales from exposure to contaminants, the possibility of indirect effects brought about by their food supply could not be ruled out.

While the number of harmful algal blooms in the northwestern Atlantic has increased in recent years, and humpback whales (*Megaptera novaeangliae*) deaths in Cape Cod Bay have been attributed to biotoxins in their prey fish, to date there has not been a recorded case of toxic algal blooms affecting right whales (Rolland et al. 2007). In theory, saxitoxins – organisms responsible for paralytic shellfish poisoning – pose a risk to right whales. The whales' feeding mechanism, filtering their plankton prey through baleen, is likely to prevent the small algal cells from being ingested (Rolland et al. 2007).

The risk posed to right whales from endocrine disrupting chemicals has not been investigated. Because of their use of coastal habitats, it is possible that right whales are exposed to some of these chemicals from run-off, sewage outflows or other sources. Exposure to endocrine-disrupting chemicals during early development has been shown to alter reproductive and immune system function in lab and domestic animals, humans and wildlife (Colborn et al.1993). Some of the current use chemicals of possible concern for right whales include: the polybrominated diphenyl ethers (flame retardants), phthalate esters (plasticizers), alkylphenol ethoxylates (surfactants) and organotin compounds (anti-fouling agents: Reeves et al. 2001).

Organochlorines, especially toxaphenes, DDT, and PCBs are present in the blubber of right whales in the western North Atlantic, but the levels are not considered high enough for great concern (A. Westgate, pers. comm.). The trends of organochlorine concentrations follow the typical cetacean pattern, with low levels in calves, slightly higher levels in juveniles, highest levels in adult males, and low to medium levels in adult females (Woodley et al. 1991, A. Westgate pers. comm.). Females offload organochlorines to their calves during gestation and lactation. Males, in contrast, continue to accumulate these compounds throughout their lives.

In Atlantic Canada there are several existing and potential point and non-point sources of contaminants. These include vessel discharges, aquaculture operations, land run-off, oil and gas activities, and dredging (through remobilization of contaminants) to name a few. Gaskin (1987) called attention to the fact that current circulation in both the Bay of Fundy and Gulf of Maine, where right whales feed, is semi-enclosed for at least part of the year. This means that contaminant gradients could become established from the inshore to the offshore regions. Recent reviews of information on contaminants in the Bay of Fundy have shown clear cause for concern (Percy et al. 1997). A wide array of contaminants, including those described above, are present in the environment and in the food web.

Acoustic disturbances

For right whales, like all baleen whales, hearing is critical to their ability to communicate, navigate and locate food. While extensive research has been conducted on the sound production and behaviour of humpback whales and southern right whales, it is only recently that greater focus has been placed on these aspects of North Atlantic right whale ecology (Parks and Clark 2007). While ambient noise levels in right whale habitat can at times be high, for example due to storm and wave activity, increasing levels of human-caused noise are a cause for concern. The two relevant components of noise are duration and intensity. Some sounds are very loud but of short duration (for example some kinds of sonar or seismic activity), while other sounds are loud and also of long duration (e.g. commercial shipping traffic) (Parks and Clark 2007).

The effects of increased noise on marine mammals are varied and may include habituation, behavioural disturbance (including displacement), temporary or permanent

hearing impairment, acoustic masking, and even mortality (Richardson et al. 1995). Increased noise can mask important social communication (e.g. mating calls, mother-calf interactions), limiting the range over which right whales can communicate (Parks et al. 2006), which in turn may reduce mating opportunities (e.g. beluga, *Delphinapterus leucas,* Erbe and Farmer 1998).

A range of anthropogenic noises in the marine waters of Atlantic Canada produce underwater sounds within the frequency range detectable by right whales (estimated to be 12 Hz to 22 kHz, with fundamental frequency of sounds produced by right whales primarily between 50 Hz and 2 kHz; Parks 2003). Within the high-use right whale habitat areas in Canada the sources of noise of most concern to date have related to commercial transport and whale watching vessels, nearby or potential oil and gas exploration, naval activities such as detonations, the use of harassment devices in aquaculture operations, marine construction, and on-shore detonations. Several kinds of sonar are operated in right whale habitat areas, including both active and passive military sonar, fish-finding sonar, and bottom mapping sonar.

It has been suggested that the constant noise from shipping in the North Atlantic has habituated right whales to ship sounds, making them less likely to avoid oncoming vessels resulting in collisions. It is also argued that right whales have no reason to avoid vessels, since they have no natural predators and these vessels are a recent introduction to their habitat, on the time scale of right whale generations. Nowacek et al. (2004) equipped several right whales with multi-sensor acoustic recording tags to measure the whales' responses to passing ships, and to test the whales' response to controlled sound exposures including recordings of ship noise, right whale social calls, and a signal designed to alert the whales. Nowacek et al. (2004) found that the whales reacted strongly to the alert signal, mildly to the social sounds, but showed no response to the sounds of approaching vessels.

No direct studies have been undertaken in Canadian waters to investigate the effects of non-vessel noise on right whales. Seismic air guns used in petroleum exploration are a source of loud noise that is a potential concern for right whale conservation. In a preliminary study, baleen whales have been observed changing their behaviour in the presence of seismic airgun noise (DFO 2004). Noise from offshore hydrocarbon production platforms and exploration drilling may also be of concern (Richardson et al. 1995), as they generally tend to be of low frequency (<500 Hz). Previous studies have demonstrated avoidance of odontocete species to acoustic harassment devices (e.g. Morton & Symonds 2002), but no data exists on baleen whale responses. Previous studies indicate that blasting for marine construction can lead to damage of ear structures in baleen whales (Ketten et al. 1993).

Vessel presence disturbance

Aside from acoustic disturbance, the presence of vessels - ranging from large commercial ships, to whale watching vessels through small recreational, scientific and fishing boats – in right whale habitat raises several concerns. In addition to noise

pollution and the risk of vessel strikes, which have been described earlier, the presence of vessels in important habitat areas may affect right whale behaviour by disturbing social interactions like nursing, or displacing them from rich food patches (e.g. such as has been documented for gray whales, *Eschrictius robustus*; Bryant et al. 1984).

Changes in food supply

The question of whether right whales in the western North Atlantic are undernourished is closely linked to the quality of their habitat and their ability to use suitable habitat without being seriously disturbed by human activities. This issue was initially addressed by Kenney et al. (1986), who suggested that inadequacy of food resources could lead to either a reduction in individual growth rates, thus lengthening the time required for sexual maturation, or insufficient blubber reserves in females to sustain pregnancy or lactation, resulting in high calf mortality. It is uncertain, at present, whether either of these changes is occurring in the North Atlantic right whale population.

Blubber thickness may be a useful index of body condition in right whales. Scientists who observe right whales in the western North Atlantic regularly see a qualitative difference in the appearance of these whales and Southern Hemisphere right whales, the latter appearing broader bodied and more robust (with a “collar of fat” in the dorsal neck region). An analysis of blubber thickness in North Atlantic right whales compared blubber thickness in different classes with reproductive success (Angell 2005). It showed that blubber thickness and dorsal body shape were indices of right whale energy balance and that the marked fluctuations in reproduction likely have a nutritional component.

Global climate change could be affecting both the local spring and summer distribution of right whales in the Gulf of Maine (Kenney 1998b) and the calving rate of the North Atlantic population (Kenney 1998a).

1.9 Critical habitat

1.9.1 General description of the species’ identified critical habitat

Critical habitat is defined in the *Species at Risk Act* (2002) section 2(1) as “…*the habitat necessary for the survival or recovery of a listed wildlife species and that is identified as the species’ critical habitat in the recovery strategy or in an action plan for the species.*”

SARA defines habitat for aquatic species at risk as: “…*spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced*.” [s. 2(1)]

For the North Atlantic right whale, critical habitat is identified to the extent possible, using the best available information, and provides the functions and features necessary to support the species’ life cycle-processes. The critical habitat identified in this

Recovery Strategy is sufficient to achieve the species' population and distribution objectives. The Schedule of Studies (Table 2) outlines the research required to identify additional critical habitat if necessary and acquire more detail about the identified critical habitat.

1.9.2 Information and methods used to identify critical habitat

In February 2007, DFO Science conducted a Recovery Potential Assessment (RPA) for right whales in the western North Atlantic. A component of the RPA was the provision of Science advice on the identification of critical habitat for this species. The RPA had two main goals in relation to critical habitat: to establish a generic definition for critical habitat (i.e., define its biophysical attributes); and to identify, if possible, candidate critical habitat areas that would meet this definition (DFO 2007, Smedbol 2007). Much of the information used to develop a description of generic critical habitat has been presented in Sections 1.4.4. and 1.4.5.

1.9.3 Identification of critical habitat

Biophysical functions, features and attributes

The RPA stated that critical habitat for right whales in Canadian waters must allow successful feeding to ensure that sufficient energy reserves are accumulated to support the energetic cost of basal metabolism, growth, reproduction, and lactation. It has been hypothesized in several studies that variation in right whale condition, reproductive rate, and spatiotemporal distribution may be related to successful foraging (Caswell et al. 1999, Kenney et al. 1995, Kenney 2001). For example, during the 1990s the average calving interval increased from 3 to 6 years (Kraus et al. 2001), and during the same period whales that had usually been sighted in Roseway Basin were seen in the Bay of Fundy (Kenney 2001). A consensus working hypothesis proposed to explain these observations (e.g. Patrician 2005) is that during this period copepod concentrations in Roseway Basin were insufficient to meet right whale energy demands, and thus right whales moved into another predictable habitat nearby – Grand Manan Basin. Grand Manan Basin may have lacked the energy reserves necessary to support the increased number of whales in the Bay, and thus may have played a role in the observed reproductive failure (increased calving intervals and fewer births). This period of extended calving intervals was followed subsequently by five years of relatively higher birth rates, a return to shorter average calving intervals. (Kraus et al. 2005) and an increase in the number of right whales observed in Roseway Basin.

Critical habitat has to provide this level of foraging success for right whales on a predictable, interannual basis. Based on what is known about prey preference of right whales and the distribution of their prey, a fairly robust, science-based description of generic critical habitat for right whales was developed through the RPA, as follows: critical habitat includes areas that possess the environmental, oceanographic and bathymetric conditions that aggregate concentrations of right whale prey, especially stage C5 *Calanus finmarchicus* copepodites, at interannually predictable locations. It is

likely that critical habitat in Canadian waters is seasonal in nature. Both right whale abundance and stage C5 *Calanus finmarchicus* concentrations peak during the late summer and early autumn in the Bay of Fundy and on the Scotian Shelf. If in the future evidence was gathered suggesting that an area in Canadian waters supported an activity or behaviour, other than feeding, that is vital to life cycle closure, then the definition of critical habitat could be re-evaluated to determine if expansion of the definition is warranted.

Table 1 summarizes the best available knowledge of the functions, features and attributes for each life-stage of the North Atlantic right whale. Note that not all attributes in Table 1 must be present in order for a feature to be identified as critical habitat.

Table 1. *General summary of the biophysical functions, features and attributes necessary for the survival and recovery of the North Atlantic right whale critical habitat (Grand Manan and Roseway Basin).*

Functions	Features	Attributes
Adult foraging and feeding Calf nursing and rearing Resting and socializing	Quantity and quality of prey	Presence of sufficient quantities and quality of C5 *Calanus finmarchicus* copepodites to support the population.
		Environmental, oceanographic and bathymetric conditions that support and aggregate concentrations of prey.
	Acoustic environment	Noise levels appropriate to allow effective social communication and foraging, and do not impede use of the critical habitat by North Atlantic right whales.
	Quality of water and air	Water and air quality at levels that support sufficient quantity and quality of prey, and do not impede use of the critical habitat by North Atlantic right whales.

Geographic identification

The critical habitat of North Atlantic right whales has been identified based on sightings data, which is referred to as the “Area of Occurrence” approach. The following definition applies when using the Area of Occurrence approach: *“Critical habitat includes the area within the identified boundaries and it is assumed that within this area, the functions and features necessary for the species’ survival or recovery exist.”*

Grand Manan Basin has been identified as critical habitat for right whales. This area matches the characteristics of critical habitat described above by supporting the highest concentrations of copepods in the Bay of Fundy (See Section 1.4.5.). The edges of Grand Manan Basin lie at about 100 m depth, and the maximum depth of the central Basin is approximately 200 m. The area is exposed to strong tides and the topography and movement of water masses in Grand Manan Basin concentrate the resident copepod population. Every year the Basin area is frequented by a substantial number of the right whales, and in some years up to two thirds of the known population have been sighted in this region. Many females with calves have been sighted in the Bay of Fundy, and a portion of these right whale mothers regularly bring calves to the Bay. Much of the

research concerning right whale habitat that has occurred in Canadian waters has been undertaken in and around Grand Manan Basin. This area has been recognized previously as an important area for right whale aggregation with the designation of the Bay of Fundy Right Whale Conservation Area (Figure 1).

A map providing the boundaries of the Grand Manan Basin and Roseway Basin critical habitat to be protected under SARA (Section 58) is provided in Figure 4.

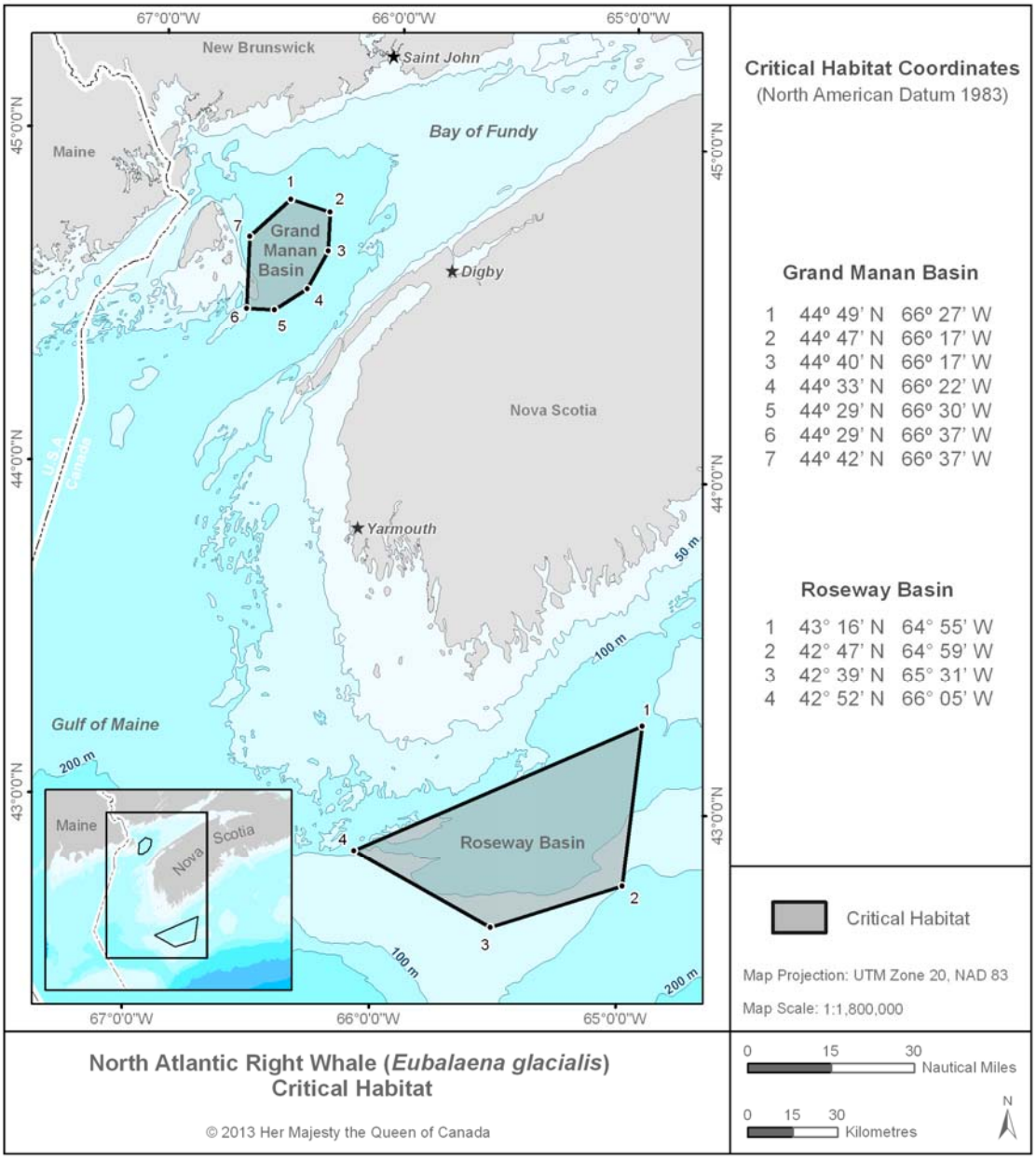

Figure 4. *Boundary of North Atlantic right whale SARA critical habitat for Grand Manan Basin and Roseway Basin. (Provided by Oceans and Coastal Management Division, DFO).*

The information used to refine the RPA advice, and derive the critical habitat boundaries, focused on available sighting data and sightings per unit effort (SPUE) analysis. This is due to the limitations associated with the prey abundance and distribution data, particularly at a regional scale. Distribution of North Atlantic right whale sightings is believed to serve as a reasonable proxy for the distribution of the prey field, which in turn is the best available indicator of the location of areas possessing the conditions that aggregate prey. Areas where concentrations of North Atlantic right whales have been sighted on an interannually predictable basis are likely to coincide with areas where interannually predictable prey concentrations occur, and hence are likely to represent areas that possess the conditions necessary to aggregate right whale prey at interannually predictable locations. The boundary encompasses the highest concentration of SPUE (NEAq) and represents approximately 90% of all right whale sightings in the Bay of Fundy from all sources (Figure 2). For administrative efficiency, a simple shape and prominent coordinates were chosen. As scientific information improves, the boundaries will be reviewed and updated as necessary to reflect the best available information.

Roseway Basin, on the southwestern Scotian Shelf, is another important area of right whale aggregation wherein right whales have been observed feeding and socializing. Mother-calf pairs have been seen in the area, but are rare. Like Grand Manan Basin, this area has been designated as a conservation area for right whales since 1993 (Figure 1). Although the RPA acknowledged the importance of Roseway Basin for right whales, it concluded that there was insufficient data on prey abundance to determine whether this area constitutes critical habitat as per the definition outlined in Section 1.9.1.

However, following the RPA, DFO and scientists from the academic community initiated a collaborative field program in Roseway Basin to address the information gaps and allow evaluation of Roseway Basin as potential critical habitat. Roseway Basin was originally identified as critical habitat (2007) based on preliminary results of an ongoing study. Since then, work has been published (Davies et al. 2013) supporting the identification of this critical habitat area based on physical and biological oceanographic attributes. Based on the available information, critical habitat has been identified in Roseway Basin in this recovery strategy (Figure 4). Boundaries have been selected to match the “Area To Be Avoided” (ATBA) designated by the International Maritime Organization (IMO; see section 2.7.1). These boundaries were determined in large part by high SPUE in the area, which was also used as a proxy for identifying critical habitat components in Grand Manan Basin (see above). The ATBA boundaries provide two additional efficiencies: they comprise the shape of a simple polygon, and the ATBA will be marked on updated nautical charts provided by the Canadian Hydrographic Service. However, the geospatial boundaries of the critical habitat may require refinement once the ongoing research has been completed, and all of the work will have to undergo the process of scientific peer review.

Other areas of critical habitat for right whales may exist, but detailed data for evaluation are not available. It is important to recognize that right whales have a migratory life history, and must be able to move in and out of critical habitat areas. Migration routes and movement corridors are required for access to habitat in Canadian waters. In addition, a sufficient amount of critical habitat must exist to allow persistence of a recovered population, and not just for current abundance. The schedule of studies outlined in Table 1 includes research activities that should help to determine whether other areas constitute critical habitat for this species.

1.9.4 Schedule of Studies to identify critical habitat

The Schedule of Studies (Table 2) outlines the studies required to identify and refine additional critical habitat necessary to support the species' population and distribution objectives and protect the critical habitat from destruction. It is anticipated that implementing the following schedule will yield information to eventually allow for identification of additional areas of critical habitat for this species.

The Schedule of Studies includes completion of the research activities discussed above to further evaluate the extent of critical habitat in Roseway Basin.

Table 2. *Schedule of Studies for North Atlantic right whales in Canadian waters to refine and identify critical habitat.*

Description of Activity	Rationale
Evaluate prey distribution in Roseway Basin, Grand Manan Basin and surrounding areas to refine critical habitat boundaries.	Right whale presence in the two critical habitat areas has varied among years, and this is thought to reflect longer-term shifts in the distribution patterns of their copepod prey. These distribution patterns are not well understood and as large-scale oceanographic conditions shift, it will be important to understand how such changes may reflect changes in right whale critical habitat.
Evaluate right whale use of areas outside of the Scotia-Fundy region (e.g. Gaspé area in the Gulf of St. Lawrence).	Sightings and acoustic data indicate the presence of right whales outside of the identified critical habitat areas, e.g. the Gulf of St. Lawrence. Further studies are necessary to help understand whether these occurrences are occasional or whether they potentially reflect the presence of critical habitat.
Determine migratory routes of right whales into and out of Canadian waters during their annual migration and evaluate potential as critical habitat.	Right whales must be able to move in and out of the critical habitat areas in Atlantic Canada. Specific migration routes and movement corridors into these critical habitat areas are not known.

1.9.5 Activities likely to result in the destruction of critical habitat

Under SARA, critical habitat must be legally protected from destruction within 180 days of being identified in a recovery strategy or action plan. For the North Atlantic right

whale, it is anticipated that this will be accomplished through a SARA Ministerial Order made under subsections 58(4) and (5), which will engage the prohibition in subsection 58(1) of SARA against the destruction of critical habitat. It is important to keep in mind that critical habitat can be destroyed from activities both within and outside of its geographic extent. Examples of activities likely to destroy critical habitat are provided in Table 3.

However, the activities described in Table 3 are neither exhaustive nor exclusive and have been guided by the threats described in section 1.8 of the Recovery Strategy for the species. The absence of a specific human activity does not preclude or restrict the Department's ability to regulate it pursuant to SARA. Furthermore, the inclusion of an activity does not result in its automatic prohibition as it is destruction of critical habitat that is prohibited, unless permitted by the Minister pursuant to the conditions of SARA section 73. Since habitat use is often temporal in nature, activities are assessed on a case-by-case basis and site-specific mitigation is applied where it is reliable and available. In every case, where information is available, thresholds and limits are associated with attributes to better inform management and regulatory decision making. However, in many cases the knowledge of a species and its critical habitat may be lacking and, in particular, information associated with a species or habitat's thresholds of tolerance to disturbance from human activities is lacking and must be acquired.

Table 3. *Examples of activities with the potential to result in the destruction of the critical habitat of the North Atlantic right whale.*

Threat	Known or possible activities	Possible Effect Pathway	Function Affected	Feature Affected	Attribute Affected
Prey removal	Capture and removal of prey species (e.g., a plankton fishery)	Reduction in the abundance and availability of prey species.	Adult foraging and feeding Calf nursing and rearing	Quantity of prey	Sufficient quantity of C5 *Calanus finmarchicus* copepodites to support the population.
Acoustic disturbance	Vessel noise (multiple sources). Types of vessel noise are described in Section 1.8.4.	Depending on the level of noise and mitigation employed, underwater noise production can cause: • alterations from natural behaviour • interference with communication • interference with feeding activities • avoidance of the area (displacement)	Adult foraging and feeding Calf nursing and rearing Socializing and resting	Acoustic environment	Noise levels appropriate to allow effective social communication and foraging, and do not impede use of the critical habitat by North Atlantic right whales
	Acute and chronic in-water and/or land-based industrial sounds (e.g. pile driving, production drilling etc.)				
	Seismic surveys using air gun arrays				
	Sonar				
Alteration of	Large scale tidal	Depending on the	Adult	Quantity of	Oceanographic

Threat	Known or possible activities	Possible Effect Pathway	Function Affected	Feature Affected	Attribute Affected
physical and biological oceanographic conditions	energy turbine developments in the Bay of Fundy	scale of development and mitigation employed, the potential to reduce the energy of the tidal cycle which in turn could persistently alter the oceanographic features within critical habitat that lead to prey aggregation.	foraging and feeding Calf nursing and rearing	prey	features and conditions (e.g., upwellings, that support and aggregate concentrations of prey)
Contaminants	Dumping and discharges of contaminants / pollution (multiple sources could include ocean dumping, industrial developments and persistent vessel discharges in and around critical habitat).	Contaminants could impact the quantity and quality of prey. Biological and ecosystem level effects may also occur.	Adult foraging and feeding Calf nursing and rearing Socializing and resting	Quality of water and air Quality and quantity of prey	Water and air quality at levels that support sufficient quantity and quality of prey, and do not impede use of the critical habitat by North Atlantic right whales.

2. Recovery

2.1 Recovery feasibility

Research and population monitoring undertaken to date indicates that recovery of North Atlantic right whales is technically feasible. A substantial amount of information concerning population abundance, trends and demography is available. The population had been driven nearly to extinction by 1900, but is considered to have been recovering slowly during the middle of the 20th century, following the cessation of whaling. The best available model of population trajectory (Fujiwara and Caswell 2001) indicated population growth rate was initially positive at the beginning of the study period in 1980, but subsequently declined to a negative value by 1995. This initial period of positive population growth has demonstrated that the North Atlantic right whale has the capacity to increase in number from critically low abundance.

The same population model suggests that population growth rates declined below replacement values during the 1990s. This estimated decline in growth was due to a decrease in survivorship over the time period, which may have been caused at least in part by an apparent increase in human-induced mortality. The two major human-induced threats are well-known, and reducing these threats is a major focus of this Recovery Strategy. Consensus among species experts is that reduction of human-

induced mortality is possible, tractable, and feasible. Mitigation measures to lessen the impact of these threats have been proposed and some have already been implemented.

For recovery to occur, it is necessary that human-induced mortality be reduced to levels that will allow for potential population growth. It is not possible currently to determine if human-induced mortality can be reduced to this level, nor is it possible currently to determine the overall probability of recovery. However if the required reduction in human-induced mortality is successfully implemented it is likely that recovery is feasible since the North Atlantic right whale has demonstrated previously in the post-whaling era that it has the capacity to increase in abundance.

2.2 Recovery goal

There are no firm estimates of historical population abundance, but rough estimates are available from two sources. Analyses of harvest data from whaling records provide estimates of historical population abundance of less than 10,000 whales. Genetic analyses suggest that historical abundance may have numbered in the hundreds to the thousands.

The lack of firm estimates of historical abundance means that a long-term target cannot yet be determined. However, current knowledge of the status and trends in this population can be used to develop interim targets until the issue of historical abundance is resolved.

The interim Recovery Goal for North Atlantic right whale is:

"***To achieve an increasing trend in population abundance over three generations***".

A period of three generations was selected to reflect the time period used by COSEWIC to evaluate declines in abundance, and subsequently adopted by DFO for use in species Recovery Potential Assessments. This criterion evaluates abundance trends over the last 10 years or three generations, whichever is the longer. The current abundance is precariously low and the best estimate of population growth rate was negative in the 1990s (Fujiwara and Caswell 2001). This decline was due to an increase in mortality, especially among mother whales, which caused declines in population growth rate, life expectancy and the mean lifetime number of reproductive events between the period 1980-1996 (Fujiwara and Caswell 2001). There is an immediate requirement to reduce the probability of extinction through fostering positive population growth rates, reducing mortality rates and increasing abundance. It is difficult to provide firm recovery targets for right whales because a clear threshold for abundance that would ensure their long-term survival is not known. Nevertheless, it is important to state a desirable (positive) trend in population growth in order to provide a context for the development and implementation of recovery measures and research activities.

Generation time in North Atlantic right whales is approximately 20 years. Therefore given an interim recovery target of "An increasing trend in population abundance over three generations," the minimum time period necessary to achieve this target is around 60 years.

2.3 Recovery objectives and strategies

Determining and maintaining the necessary conditions both within Canadian waters and abroad in efforts to achieve an increasing trend in population abundance of North Atlantic right whales over three generations will be accomplished by implementing the following recovery objectives and respective strategies. There is a need for Canada to commit effort and resources to support the implementation of the seven recovery objectives and their respective strategies:

Objective 1: *Reduce mortality and injury as a result of vessel strikes;*

Objective 2: *Reduce mortality and injury as a result of fishing gear interactions (entanglement and entrapment);*

Objective 3: *Reduce injury and disturbance as a result of vessel presence or exposure to contaminants and other forms of habitat degradation;*

Objective 4: *Monitor population and threats;*

Objective 5: *Increase understanding of life history characteristics, low reproductive rate, habitat and threats to recovery through research;*

Objective 6*: Support and promote collaboration for recovery between government agencies, academia, environmental non-government groups, Aboriginal groups, coastal communities and international agencies and bodies;*

Objective 7: *Develop and implement education and stewardship activities that promote recovery.*

Following each objective is a series of strategies that, when implemented, will contribute to the fulfillment of the corresponding objective. These strategies are designed to provide sufficient detail to facilitate the application of SARA, and to assist the next step of recovery planning, which is the development of recovery action plans.

Objective 1*: Reduce mortality and injury as a result of vessel strikes.*

Rationale: Vessel strikes remain the most serious documented threat to right whales. To increase the chances for survival, the number and severity of collisions need to be reduced.

Strategies:

a. Better understand the relationship between vessel activity and right whales by evaluating the risk of vessel collisions based on analysis of all available data on the seasonal and inter-annual distribution of right whales and vessel traffic in Canadian waters.
b. Consider, evaluate and implement management strategies that reduce the amount of overlap, in time and space, between vessel activity and right whales (e.g. advisories, routing, speed reduction).
c. Collaborate with shipping interests and operators about ways in which they can, through measurable voluntary action, reduce the number/frequency of interactions between right whales and vessel operations.

Objective 2*: Reduce mortality and injury as a result of fishing gear interactions (entanglement and entrapment)*.

Rationale: A serious threat to right whales is injury and mortality from fishing gear interactions in Canadian waters: this may affect the survival of the species. To increase the chances for survival, the number and severity of entanglements or entrapments must be reduced.

Strategies:

a. Evaluate, promote, and/or implement where necessary, strategies (*e.g.* gear modifications, effort restrictions) that will reduce the potential for harmful interactions between fishing gear and right whales. Collaboration between researchers, fishers and resource managers on the development and field-testing of modified fishing practices will assist in the identification and application of mitigation measures.
b. Evaluate and minimize the effects of all new and expanding fisheries on right whales.
c. Collaborate with fishers about ways in which they can, through measurable voluntary action, reduce the number/frequency of interactions between right whales and fishing operations.
d. Support emergency response and disentanglement programs in eastern Canada that are able to rapidly respond to reports of entangled or entrapped right whales.

Objective 3: *Reduce injury and disturbance as a result of vessel presence or exposure to contaminants and other forms of habitat degradation.*

Rationale: A variety of existing or emerging threats to right whales and the quality of their habitat will need to be addressed and reduced where possible. Mitigation activities, including those carried out through stewardship, will be required based on outcomes of research and further identification of the threats. Lack of full knowledge or understanding of threats should not preclude proactive work to reduce risk to right whales and their habitat.

Strategies:

a. Evaluate and reduce the harmful impacts of dangerous substances on right whale habitat including both natural and human-induced sources. Both chronic and acute sources of contamination (*e.g*. oil spills, vessel discharges, and coastal sources) should be addressed. Particular focus will be on reducing substances with greater risk to the immune system or reproductive success of right whales.
b. Evaluate the potential impacts from existing or future human induced noise in right whale habitats and reduce harmful levels of exposure.
c. Evaluate and reduce the disturbance associated with vessel presence *e.g*. commercial shipping, fishing, whale watching, recreational boating and research activities.

Objective 4: *Monitor population and threats.*

Rationale: Knowledge about the population status and their distribution in Canadian waters is incomplete. Monitoring of the population, particularly in known habitat areas, is required to evaluate whether the recovery goal of increasing the population will be met. Similarly, monitoring the nature and level of key threats to right whales is an ongoing requirement in order to respond to issues in a timely manner. Section 2.5 provides a full list and description of information gaps.

Strategies:
a. Promote and conduct regular monitoring of right whales throughout Canadian waters and in particular in known habitat areas.
b. Promote and conduct regular monitoring of existing and emerging threats.
c. Support necropsies of dead animals in Canadian waters to help identify and evaluate the effects of human activities.

Objective 5: *Increase understanding of life history characteristics, low reproductive rate, habitat and threats to recovery through research.*

Rationale: Knowledge about the biology of right whales, their distribution, their historic abundance, the threats to recovery, and the effectiveness of mitigation measures in Canadian waters is incomplete. Research on these issues is required to guide the application of all recovery activities to protect the species and its habitat. Section 2.5 provides a full list and description of information gaps.

Strategies:
a. Promote and conduct research on right whale life history, historic abundance, habitat requirements and distribution.
b. Promote and conduct research to further understand the factors limiting reproductive success.
c. Promote and conduct research of existing and emerging threats and effectiveness of mitigation measures.

d. Conduct research and analysis to further understand or refine critical habitat in Roseway Basin, and to evaluate the potential for identification of critical habitat in other areas (see Schedule of Studies Section 1.9.3.).

Objective 6: *Support and promote collaboration for recovery between international agencies and bodies and between government agencies, academia, environmental non-government groups, Aboriginal peoples and coastal communities in Canada.*

Rationale: Protection and recovery of right whales is a shared responsibility with regulators and user groups and communities across their range in Canada. In Canada regulators such as DFO (including Coast Guard), Transport Canada, and Foreign Affairs have important and complementary roles. However, foreign governments and international bodies also have responsibilities and/or an interest in protecting this species. Information exchange and conservation efforts, often in the form of recovery action plans, among these various interests should be coordinated and formalized, where appropriate.

Strategies:

a. Support the maintenance of an ongoing multi-stakeholder advisory body in which to discuss right whale conservation and recovery issues.
b. Promote collaboration and coordination among decision makers and levels of government to foster joint conservation efforts and communication surrounding right whale conservation.
c. Promote the involvement of Aboriginal peoples and perspectives in recovery activities.
d. Engage coastal communities and resource user groups in discussions and collaborations to foster right whale recovery and promote the gathering of knowledge of right whales from interested groups.
e. Continue to collaborate with government agencies in the United States on transboundary right whale initiatives.
f. Work with international bodies on right whale conservation issues of interest to Canada.

Objective 7: *Develop and implement education and stewardship activities that promote recovery.*

Rationale: Education and outreach efforts are important tools to promote recovery efforts with stakeholders and the public at large. Specific materials and programs should be developed targeting a variety of audiences, and maintained and updated frequently.

Strategies:

a. Continue to expand, refine, and update programs to educate mariners about the problems facing right whales, available shore-based resources, and how changes to vessel operations will help address those problems. Targeted groups include: whale watch operators, commercial vessel traffic, cruise ships and recreational boaters, fishers and researchers (see Objectives 1 to 3).

b. Expand and refine collaboration efforts with the fishing industry that promote best practices to reduce the number and severity of whale/fishing gear interactions.
c. Promote a public reporting system for dead, stranded, injured, entangled or entrapped right whales as part of the existing whale disentanglement response program.
d. Develop programs to educate the general public about right whale conservation strategies and stewardship actions.

2.4 Performance indicators

Measurable performance indicators are a critical component of right whale recovery action plans to gauge the extent that recovery activities contribute to the stated recovery goal for the species. A set of progress indicators have been devised for each of the strategies identified under the seven recovery objectives. At this stage, many of the indicators reflect the current lack of knowledge about right whales, and have been also identified as research activities. During regular intervals, the recovery strategy and action plans will be reviewed; progress indicators should be revised to reflect increasing knowledge. Indicators outlined in Table 4 therefore are preliminary, and subject to change as knowledge increases and as recovery action plans are implemented.

Table 4. *List of general indicators of progress to assist in determining the extent that recovery is being achieved. Each set of indicators corresponds to a specific recovery objective for North Atlantic right whales in Canadian waters.*

Recovery Goal ***To achieve an increasing trend in population abundance over three generations***		
Recovery Objective	**Measure of Progress**	**Performance Indicator**
Objective 1: *Reduce mortality and injury as a result of vessel strikes.*	• Management strategies and options to reduce risk have been evaluated and appropriate action taken • Information on traffic patterns is maintained and areas of risk identified	• Rate of interactions in Canadian waters declines • Regular analysis of vessel/right whale risk and mitigation measures is conducted
Objective 2: *Reduce mortality and injury as a result of fishing gear interactions (entanglement and entrapment)*.	• Potential/known interactions of right whale and all fishing industry activities are identified, monitored and documented • Management strategies and options to reduce interactions have been evaluated and prioritized with the fishing industry • Disentanglement and emergency response	• Rate of interactions in Canadian waters decline • Regular analysis of gear/right whale risk and mitigation measures is conducted • Increased involvement in mitigation efforts by fisheries associated with higher risk gear • Possible disentanglement efforts are conducted

	capacity is in place *i.e*. networks of trained responders	
Objective 3: *Reduce injury and disturbance as a result of vessel presence or exposure to contaminants and other forms of habitat degradation*	• Potential/known threats to habitat have been identified and documented • Mitigation measures developed to reduce known harm to habitat quality from human activities have been evaluated and implemented	• Assessment of impacts of contaminants on right whales are completed • Harmful levels of noise in North Atlantic right whale habitat is taking place at acceptable levels and durations • Human-induced impacts on food supply are understood and reduced where possible
Objective 4: *Monitor population and threats.*	• Population monitoring activities are conducted regularly • Monitoring of existing and emerging threats is regularly conducted • Historic and current sightings are compiled and updated. • Knowledge from monitoring activities is accessible to a broad range of user groups •	• Information collected in monitoring programs is disseminated • Regular forums to discuss monitoring results are held • Necropsies are conducted when possible
Objective 5: *Increase understanding of life history characteristics, low reproductive rate, habitat and threats to recovery through research.*	• Priority knowledge gaps have been addressed • Knowledge from research activities accessible to a broad range of user groups • Critical habitat studies have been completed	• Research is published • Regular forums to discuss research results and threat mitigation are held • Critical habitat in Canadian waters is identified and protected
Objective 6: *Support and promote collaboration for recovery between government agencies, academia, environmental non-government groups, Aboriginal groups, coastal communities and international agencies and bodies.*	• Regular meetings among interested parties to discuss right whale conservation are held • Aboriginal peoples' participation in right whale conservation efforts • Canadian participation in international and bilateral discussions to promote right whale protection and recovery • Efforts to coordinate research across jurisdictions of the North Atlantic are underway	• Successful implementation of right whale conservation activities increases • Cooperative bilateral or multilateral arrangements to advance right whale research and conservation
Objective 7: *Develop and implement education and stewardship activities that promote recovery.*	• Awareness programs are underway to target key user groups, government, and the general public • Evaluation of the effectiveness of outreach	• Measured increase in awareness and support for recovery activities • Key user groups work to develop and implement best practices (stewardship)

	efforts • Public have ability to report dead, stranded, entangled and entrapped right whales	• Right whale emergencies are reported in a timely fashion

2.5 Knowledge gaps

There are a number of gaps in our knowledge about the right whale in Canadian waters. These gaps occur in areas of current and potential threats, biology and ecology, and habitat requirements. The following is a list of priority actions that are required to fill the knowledge gaps.

2.5.1 Threats

1. Evaluate existing or potential mitigation techniques that reduce vessel strikes in Canadian North Atlantic right whale habitat;

2. Identify mechanisms involved in North Atlantic right whale responses to oncoming vessels, *e.g*. ability to avoid vessel strikes to help design potential mitigation;

3. Identify nature of entanglements and evaluate potential mitigation techniques, such as gear modification, that may reduce entanglement or entrapment in fishing gear that is used in Canadian waters (existing and new fisheries);

4. Evaluate the overlap in space and time of North Atlantic right whales and fishing gear to help design potential mitigation;

5. Identify response mechanism of right whales to acoustic stimuli, and definition of harmful effects to help design potential mitigation;

6. Identify contaminant levels in right whales and contaminant sources in their Canadian habitat;

7. Identify the potential for harmful effects from recreational or research activities and determine thresholds to help design mitigation;

8. Investigate and evaluate potential threat from pathogens.

2.5.2 Ecology and biology

1. Investigate the reason for lower than normal reproductive rate;

2. Investigate the population distribution and abundance outside of the two known areas of right whale concentration in Canadian waters;

3. Investigate the right whale mating system and sources of impaired reproductive success;

4. Investigate the physiological condition of right whales in relation to their reproductive performance;

5. Investigate the increasing variability in annual calf production and inter-calf interval through time;

6. Develop reliable estimate of historical (pre-whaling) population abundance, for use in determination of a recovery target;

7. Collect pertinent traditional knowledge of the Aboriginal peoples of Canada.

2.5.3 Habitat

1. Identify any additional critical habitat in Canadian waters;

2. Identify factors and indicators influencing shifts in habitat preference and use;

3. Identify wintering ground(s) used by males and by females not due to give birth;

4. Identify location of the non-Bay of Fundy nursing grounds;

5. Identify prey distribution and production in eastern Canadian waters, and its relationship to the annual distribution of right whales;

6. Identify and model oceanographic processes that influence spatial and temporal distribution of right whales in Canadian waters.

2.6 Statement of when one or more recovery action plans will be completed

Recovery action plans are the documents that lay out how recovery strategies are to be implemented. The action plans take recommendations from the recovery strategy, either individually or collectively, and chart out who needs to be involved and to what extent in carrying out the proposed activities.

It is expected that the action plan for this species will be developed in multiple chapters outlining steps to be taken to implement the recovery strategy. The first chapter will be developed within two years of the posting of this strategy, with a second developed no later than five years after the posting of this strategy. Two priorities that have been identified thus far for action planning include reviewing critical habitat identification for Roseway Basin based on ongoing research and addressing potential interactions with fishing gear.

In the interim, work can still begin and continue on many of the strategies in this document. Therefore, recovery implementation will be an ongoing activity that can occur in the absence of any formal action plan. Furthermore, the Recovery Strategy recognizes the need for adaptive management; as new information becomes available, the actions for recovery may be modified.

2.7 Actions completed or underway

Many right whale research, conservation and stewardship, outreach and recovery efforts have been initiated by government and non-government organizations in the past 20 years. The Right Whale Recovery Team was first assembled in 1997 and published a recovery plan in 2000 that outlined the key issues facing the right whale and the research and actions required to encourage recovery (WWF/DFO 2000). Many of the actions proposed in that plan were completed or are currently underway. The following provides the highlights of actions undertaken to date, with details and references to many of the studies described throughout Section 1 (Background).

2.7.1 Mitigation of threats

The Habitat Stewardship Program (HSP) has provided financial support to a variety of right whale projects in Atlantic Canada, promoting direct involvement of a wide number of community and industry groups and individuals involved in recovery efforts. Projects have included the collection of sightings data to the development of specific mitigation activities with industries or user groups that could affect right whales.

The two areas in which North Atlantic right whales congregate in Canadian waters were designated as “Conservation Areas” by Fisheries and Oceans Canada in 1993 - one in the Grand Manan Basin in the lower Bay of Fundy and one in Roseway Basin on the western Scotian Shelf. The overall goal of this non-regulatory designation was to raise mariners’ awareness of North Atlantic right whales, *e.g*. included areas on relevant navigation charts. Thus far, the most significant conservation achievement in Canada has been the 2002 adoption by the International Maritime Organization and 2003 relocation of the Bay of Fundy Traffic Separation Scheme (shipping lanes) from an area with high right whale density into an area with lower right whale density. This work led by external partners and supported by Transport Canada reduced the relative potential for accidental collisions by approximately 80%. This amendment was successfully implemented by Canadian Hydrographic Service and the Canadian Coast Guard modifying navigational charts, notices to mariners, sailing directions and vessel traffic procedures. In 2007, Transport Canada submitted another proposal to IMO for the designation for a recommendatory and seasonal Area to Be Avoided on Roseway Basin, south of Nova Scotia for all vessels of 300 gross tonnage and above. The Maritime Safety Committee of IMO adopted this measure in October 2007 as a Recommended Seasonal Area to be Avoided (ATBA; coordinates 43° 16’ N 064° 55’ W; 42° 47’ N 064° 59’ W; 42° 39’ N 065° 31’ W; 42° 52’ N 066° 05’ W) and it was implemented in May 2008.

Outreach to marine vessel operators has been a high priority of the recovery team to reduce accidental collisions and disturbance to North Atlantic right whales, particularly in key habitat areas, *i.e*. Grand Manan and Roseway Basin. Inclusion in the Annual Notice to Mariners, Sailing Directions, educational brochures, wheelhouse placards, and seasonal Canadian Coast Guard whale alerts are aimed at achieving this goal. The aim is to encourage them to avoid these areas if possible, and to provide guidance to the marine vessel community while in the presence of whales.

A Code of Ethics was established by a non-profit organization working with whale-watching operators to minimize the impact of this activity on right whales. All of the Bay of Fundy whale-watching companies have accepted the guidelines and work is ongoing to implement in all areas of the Bay of Fundy. Whale watching and ecotourism operators throughout Atlantic Canada and Quebec have adopted similar codes of ethics to reduce interactions with large whales, including right whales.

A protocol has been established for releasing entangled whales from fishing gear. There are a number of first responders in Canadian waters. In addition to the Grand Manan Whale and Seabird Research Station and other groups in Nova Scotia, the volunteer Campobello Whale Rescue Team responds to entanglements in Canadian waters (primarily the lower Bay of Fundy) and collaborates with US based rescue groups at the Provincetown Center for Coastal Studies and the New England Aquarium.

In 2006, a relatively large number of right whales remained close to mainland southwest New Brunswick (SWNB) late into the fall. Reactive management measures were worked out with the fishing associations, DFO, scientific interests and environmental groups involved to allow the lobster fishery in Lobster Fishing Areas (LFAs) 36 and 38 to proceed with reasonable protection for the whales. At the same time, a voluntary Code of Conduct for those fishing near right whales was also developed. In 2007, in conjunction with the same groups, the SWNB Area office developed a proactive Right Whale / Lobster Fishery Mitigation Strategy for these LFAs which provided guidelines for lobster harvesters to reduce the risk of interactions with right whales in the lobster fishing grounds. A 24-hour hotline was established at the Grand Manan Fishermen's Association to record and provide up-to-date information on the location of right whales. Furthermore, World Wildlife Fund (WWF)-Canada and DFO are currently working with the fishing industry in evaluating various options, including the testing a variety of alternative types of fishing gear, that may reduce the likelihood of whale entanglements.

A variety of efforts are underway in Maritimes Region that aim to provide an integrated, ecosystem based and collaborative ocean management framework. These include the Southwest New Brunswick Marine Resources Planning initiative and the Eastern Scotian Shelf Integrated Management (ESSIM) initiative. These efforts involve a variety of stakeholders and regulators and provide a planning forum in which to develop and implement ecosystem objectives and indicators to guide the management of a variety of activities, including those that affect the right whale.

2.7.2 Research

Researchers from the New England Aquarium (Boston MA) and their collaborators continue to survey for right whales each year in Canadian waters during August and September; in Grand Manan Basin in the lower Bay of Fundy and Roseway Basin on the Scotian Shelf. Regular boat-based surveys are occasionally supplemented by aerial surveys. The researchers monitor population size and calf survival, as well as collecting skin, blubber and faecal samples for use in studies on genetics, contaminants, hormones, and life history.

Photographs taken during research and monitoring studies of right whales are used to identify individual whales based on unique markings. Photographs from many studies are compiled and archived in an extensive photographic catalogue and database at the New England Aquarium. The catalogue permits researchers to use these data to monitor life history parameters (births, deaths, reproductive success, habitat use patterns and abundance) and the rate of human-induced scarring on right whales.

Collaborative research projects underway at the St. Andrews Biological Station include an evaluation of response of right whales to vessel activity, the creation of an East Coast whale sightings database, and efforts to understand the distribution of right whales and their habitat in Canadian waters. Whale identification training is provided to members of the marine industry; such as whale watch naturalists and other mariners working in the Bay of Fundy who voluntarily report sightings and to increase the amount of sighting data in the early and latter part of the season. It is thought that these stewardship programs may lead to the discovery of new areas of right whale activity in addition to the well known area in the Grand Manan Basin.

DFO and Dalhousie University have a project underway designed to assess the risk of entanglement posed by fishing gear to right whales in the Bay of Fundy. The analysis is investigating which fisheries and gear sectors pose the greatest risk to right whales. The results will be used to advise industry and fishery management on actions that would minimize the risk to right whales while at the same time attempting to minimize disruption of the commercial fisheries in the region. In 2004-2005, WWF-Canada held meetings with industry representatives and produced a draft discussion paper exploring options for reducing entanglement. These efforts by WWF-Canada have resumed in 2007 through support of HSP and other funders, with a focus on working with the fishing industry to develop and implement solutions which will reduce right whale entanglements. WWF-Canada, in collaboration with oceanographic researchers at Dalhousie University have funded a post-doctoral fellow to conduct a quantitative analysis of right whale distribution and the risk of fishing activities in Canadian waters.

Dalhousie University, together with several partners, is conducting an evaluation of vessel traffic and right whale strike probabilities along the coast of North America. This effort compiles available time and space data related to both vessels and right whales in an effort to identify areas where risk of collisions is greatest and to determine the effectiveness of mitigation efforts, *e.g*. Roseway ATBA. The results will support the

investigation and development of future management strategies with the maritime user community.

2.8 Allowable activities

This Recovery Strategy is not using Subsection 83(4) of SARA to exempt persons from the prohibitions of SARA as they relate to this species.

2.9 Anticipated conflicts or challenges

While there has been significant progress in narrowing knowledge gaps in recent years, it is widely accepted that research efforts must continue and increase. A major challenge facing the recovery of right whales is the lack of knowledge about several important aspects of the species and how to reduce threats. The need for consistent resources and a support network of partners with stable funding opportunities to address knowledge gaps, implement recovery strategies and respond to right whale emergencies is part of this challenge. Accordingly, areas where more information and resources are needed have been identified in this strategy.

The migratory and pelagic habits of the species present a significant challenge to fully implement all recovery strategies. Recovery of the right whale will require significant international coordination and cooperation to reduce or remove the negative impacts of human activities across the species' range.

Targeted studies and stewardship actions in the implementation phase of recovery are expected to yield a better understanding of what is needed to achieve a viable population (and hence recovery) of right whales in Atlantic waters. A long time scale for recovery must be considered in evaluating the ultimate success of recovery measures. In the absence of complete information, however, recovery actions are still possible and are promoted as key objectives in this strategy. Through an iterative and adaptive approach to recovery, new information will inform the development of further mitigation measures and strategies for recovery implementation.

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Recovery Team Members

Members listed have a pertinent interest, knowledge or expertise associated with North Atlantic right whales, represent a stakeholder organization, industry or government agency, have participated in at least one meeting during the 2005-2007 period and/or have contributed directly to the development of this document.

Membership of the North Atlantic Right Whale Recovery Implementation Team

Co-chairpersons

Jerry Conway	DFO, Fisheries & Aquaculture Management
Moira Brown	Canadian Whale Institute and New England Aquarium

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Brown, Randy	DFO, Canadian Coast Guard
Bull, Arthur	Bay of Fundy Marine Resource Council
Cartwright, Barb	International Fund for Animal Welfare
Cronk, Ron	NB Dept of Fisheries
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Stephenson, Rob	DFO, Science (St. Andrews Biological Station)
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Walsh, Gary	DFO, Canadian Coast Guard
Wimmer, Tonya	World Wildlife Fund Canada

Appendix A: Further Information

Emergency Contact number for entangled, entrapped, stranded or dead right whales:

In Maritimes: Fisheries and Ocean Canada Environmental Emergencies, Regional Operations Centre
902-426-6030 or 800-565-1633

In Nova Scotia: Marine Animal Response Society (MARS)
1-866-567-6277

In Quebec: Quebec Marine Mammal Emergency Response Network
1-877-7baleine (1-877-722-5346)

In Newfoundland and Labrador: Whale Release and Stranding Group
1-888-895-3003

Weblinks:

Canadian Whale Institute
http://www.canadianwhales.org
http://www.rightwhale.ca

Grand Manan Whale & Seabird Research Station:
http://www.gmwsrs.org/whales.htm#Right

International Fund for Animal Welfare Campobello Whale Rescue Team:
http://www.ifaw.org/ifaw_canada_english/join_campaigns/protecting_whales_around_the_world/protecting_whales_and_their_habitats/protecting_endangered_whales/saving_north_atlantic_right_whales/all_tangled_up-_the_threat_of_fishing_gear.php

New England Aquarium:
www.neaq.org/rwcatalog

North Atlantic Right Whale Consortium:
www.rightwhaleweb.org

St Andrews Biological Station Species at Risk Group:
http://www.mar.dfo-mpo.gc.ca/SABS/Home

Marine Mammal Critical Areas
http://www.notmar.gc.ca

World Wildlife Fund
http://www.wwf.ca

World Conservation Union List of Threatened Species:
http://www.iucnredlist.org/

Species at Risk Public Registry
http://www.sararegistry.gc.ca/

Aquatic Species at Risk – Fisheries and Oceans Canada
http://www.dfo-mpo.gc.ca/species-especes/species-especes/rightwhaleNA-baleinenoireAN-eng.htm

Appendix B: Glossary of Terms

Action Plan: Document required by SARA that outline the measures needed to meet the objectives set out in a recovery strategy, and indicates when they are to take place, and who should be involved.

Allele: One of several possible mutational states of a particular gene or locus (gene location).

Anthropogenic: Caused by humans.

Baleen: Series of overlapping plates, made of fingernail-like material called keratin, which hang down from the whales' upper jaw and filter zooplankton.

Basal metabolism: The minimum amount of energy required to maintain vital functions in an organism at complete rest.

Bathymetry: The representation of depth of bodies of water.

Biotoxins: Any toxin (i.e., poison) that is produced by a living organism (plant, animal, fungi, bacteria, etc.).

Callosities: Gray or black thickened patches of skin found on the rostrum, behind the blowholes, over the eyes, on the corners of the chin, and variably along the lower lips and jaws in patterns unique to each right whale and used by researchers to identify individuals; usually white or cream-coloured due to infections of whale lice.

Caloric buffer: Related to the thick protective layer of blubber that helps maintain the whale's body heat.

Calving: To give birth to a calf, a newborn whale.

Chromosome: Microscopic, threadlike part of a cell that carries the genetic information (DNA) of an organism.

COSEWIC: Committee on the Status of Endangered Wildlife in Canada, a committee of experts that assesses and designates species at risk of being lost from the wild in Canada.

Critical Habitat: The habitat necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species.

Endangered (E): As defined by COSEWIC, a wildlife species facing imminent extirpation or extinction.

Endocrine disrupting chemicals: Any chemical that interferes with the body's system of glands (i.e., endocrine system) and disrupts the function of the body's chemical messengers called hormones.

Entanglement: One of the major threats to North Atlantic right whales; the ensnarement of an individual in fishing gear.

Epidemiological: Relating to the study of the distribution of diseases in populations and of factors that influence the occurrence of disease.

Feasibility: In the context of recovery, the concept of feasibility involves both the biological (intrinsic capabilities of a listed species or population to achieve a viable population status – e.g., availability of sufficient individuals capable of reproduction, availability of suitable habitat) and technical (ability of organizations and jurisdictions that are responsible for recovery to respond to the needs of a species – e.g., threat mitigation, effective recovery techniques) potential for recovery of a listed species at risk.

Fluke: Either of the two horizontally flattened lobes of a whale's tail.

Gene: A hereditary unit consisting of a sequence of DNA that occupies a specific location on a chromosome and determines a particular characteristic in an organism.

Gene Complex: Cluster of functionally related genes; a group of genes occurring close together on the same chromosome that perform similar roles in a biological function.

Genetic bottleneck: An evolutionary event in which a population's size is greatly reduced and genetic drift is increased, reducing the population's genetic variation and thus its ability to adapt to new selection pressures, such as climatic change or a shift in available resources. They may also increase inbreeding due to the reduced pool of possible mates.

Genetic diversity: The genetic variation that provides a mechanism for population to adapt to their ever-changing environment.

Genetic Drift: Random change of allele frequencies, within and among populations of a species, due to chance. Drift occurs more rapidly in smaller populations, and may result in loss or fixation of alternative alleles in different populations of a species.

Genotype: The genetic makeup, as distinguished from the physical appearance, of an organism or a group of organisms.

Growth rate: Change in the number of individuals in a population over time.

Habitat degradation: Reduction in habitat quality due to factors such as contaminants, exposure to excessive noise, and changes in food supply as a result of human activities.

Haplotype: One of the alternative forms of the genotype of a gene complex.

Homogeneously: from the adverb homogeneous, meaning of the same, uniform.

Interbreeding: Breeding (i.e., production of young) between different, albeit closely-related species. The term is related to hybrid.

Intrinsic factors: Inherent factor, belonging to the essential nature of an individual.

K-selected: A life history strategy that includes long generation times and low annual reproductive rates.

Loci: Plural of locus; A fixed position on a chromosome occupied by a gene, one of the alleles of the gene, or by any defined DNA segment.

Major Histocompatibility Complex (MHC): A large DNA sequence region or group of genes found in most vertebrate species.

Matriline: Line of descent as traced through females on the mother's side of a family.

Minisatellite and Microsatellite markers: Repetitive stretches of short sequences of DNA used as genetic markers to track inheritance in families.

Migratory corridor: Area that facilitates the migration (i.e., movements) of individuals or groups between two habitats (e.g., feeding and nursery grounds).

Mitigation: Measures taken to reduce adverse impacts of an activity on a species or its habitat.

Mitochondrial DNA: Mitochondrial DNA (mtDNA) is the genetic material found in mitochondria, the organelles that generate energy for the cell.

Mortality: Death of individuals in a population.

Necropsy: An examination and dissection of a dead organism to determine cause of death or the changes produced by disease; synonymous to autopsy.

Nomenclature: The procedure of assigning names to the organisms of a particular group or category (i.e., taxonomic classification).

Odontocete: Taxonomic category of whales that have teeth. Members of this group include all dolphins, all porpoises, the beaked whales, killer whales, sperm whales, and a few others.

Outreach: Efforts by an organization or group to connect its ideas or practices to the efforts of other organizations, groups, specific audiences or the general public. Outreach often takes on an educational component.

Parturition: The action or process of giving birth to offspring.

Photo-identification: Identification of a particular individual through use of a photograph.

Recovery: The restoration of a species to a viable, self-sustaining population level, able to withstand random events and other environmental variables.

Recovery Potential Assessment: A science evaluation framework used as a basis for decisions relating to the recovery planning of a species at risk.

Reproductive isolation: Mechanisms that prevent two or more populations from interbreeding with each other and forming viable, fertile offspring.

Reproductive rate: Number of young per animal per unit of time.

Rostrum: Upper jaw of a whale; can refer to the beak composed of the upper and lower jaws.

Seismic: In this document, it refers to a method of probing the seafloor with sound energy produced from the propagation of elastic waves beneath the surface of the earth, usually as an aid in searching for economic deposits of oil, gas or minerals, but also for engineering, archaeological and scientific studies. Scientists use a device called an air gun to initiate a burst of compressed air at the ocean's surface which creates intense sound pressure pulses that travel through the water. The intensity and timing of the echoes from the ocean bottom provide information about buried geological structures.

Stewardship: Management of the heritage of our natural spaces and species in such a way that it can be passed on to future Canadians intact.

Stratification: Formation of separate layers in a water body.

Survival: The condition in which a species continues to exist into the future while retaining the potential for recovery.

Synergistic: The interaction of two or more agents or forces so that their combined effect is greater than the sum of their individual effects.

Thermocline: A distinct layer in a large body of water, such as an ocean or lake, in which temperature changes more rapidly with depth than it does in the layers above or below.

Thermal front: Region or boundary separating two masses of different temperatures.

Threat: Any activity or process (both natural and human-induced) that has caused, is causing, or may cause harm, death, or behavioural changes to a species at risk or the destruction, degradation, and/or impairment of its habitat to the extent that population-level effects occur.

Topography: The surface features or configuration of an area.

Upwelling: A process in which relatively cold, usually nutrient-rich waters from the ocean depths rise to the surface.

Whaling: To engage in the hunting of whales.

Zooplankton: Broad categorisation spanning a range of sizes of small floating or weakly swimming organisms that drift with water currents and comprise the food supply of many marine species, including the North Atlantic right whale.

Appendix C: Record of Consultations

The North Atlantic right whale (*Eubalaena glacialis*) is a large marine mammal under the federal jurisdiction of Fisheries and Oceans Canada. A migratory animal, the North Atlantic right whale travels along the east coast of North America primarily from eastern Florida to the Gulf of St. Lawrence and Newfoundland. Because of the transboundary and multi-regional scope of the species and the breadth of knowledge and expertise in relation to the species, broad engagement and consultations were sought in the development of the recovery strategy.

The North Atlantic Right Whale Recovery Implementation Team played a key role in providing input into the recovery strategy. DFO Maritimes Region co-chaired this team of experts and representatives from multiple levels of government, including the US National Marine Fisheries Service, and stakeholder groups such as environmental non-government organizations, academia, research organizations, Aboriginal communities and the fishing industry. Specific members of the Recovery Team and their affiliations can be found on page 54 of this recovery strategy. Input on this strategy was sought from all members of the Recovery Team.

In addition, the scientific elements of the strategy, namely sections 1.9 (critical habitat), 2.2 (recovery goal) and 2.8 (allowable activities) were informed through a full peer review organized by the Canadian Science Advisory Secretariat.

The strategy was also reviewed by DFO representatives in the National Capital Region and relevant DFO regions (including Québec, Gulf, Newfoundland and Labrador), and relevant provincial government representatives from Québec, Nova Scotia, New Brunswick and Newfoundland. All comments received during this level of review were considered.

Engagement in the activities of the Recovery Team and additional input into this strategy were also sought from relevant First Nations and Aboriginal communities. The document was circulated to Aboriginal communities, who were subsequently contacted for input. Any comments received during this review were incorporated into the document.

Comments received on the proposed recovery strategy during the 60-day public registry comment period (January 8, 2009 to March 9, 2009) were incorporated in the final version of the document.