COSEWIC
Assessment and Update Status Report

on the

Harbour Porpoise
Phocoena phocoena

Northwest Atlantic population

in Canada

SPECIAL CONCERN
2003

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

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Previous report:

Gaskin, D.E.. 1991. COSEWIC update status report on the harbour porpoise *Phocoena phocoena* (Northwest Atlantic population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 60 pp. [Note: 1990 status report never finalized but 1991 status report revised to include new information.]

Gaskin, D.E.. 1990. COSEWIC status report on the harbour porpoise *Phocoena phocoena* (Northwest Atlantic population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 60 pp.

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Harbour porpoise (Northwest Atlantic population) — Photograph by: Ari S. Friedlaender, Beaufort, N.C.

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COSEWIC
Assessment Summary

Assessment Summary – May 2003

Common name
Harbour porpoise (Northwest Atlantic population)

Scientific name
Phocoena phocoena

Status
Special Concern

Reason for designation
Harbour porpoise are widely distributed and can be divided into three populations that summer in the Gulf of Maine/Bay of Fundy, the Gulf of St. Lawrence, and Newfoundland-Labrador. Many animals (probably thousands and perhaps a significant proportion of the population) die each year due to incidental capture in fisheries. Reduced fishing for groundfish may have lowered bycatch, but the benefits to porpoise, if any, need to be quantified. Management plans to reduce bycatch are only in place in the Gulf of Maine/Bay of Fundy. Harbour porpoise can be excluded from important habitat by acoustic harassment devices associated with aquaculture.

Occurrence
Atlantic Ocean

Status history
Designated Threatened in April 1990. Status re-examined and confirmed in April 1991. Downlisted to Special Concern in May 2003. Last assessment based on an update status report.

COSEWIC
Executive Summary

Harbour Porpoise
Northwest Atlantic population
Phocoena phocoena

Harbour porpoises are among the smallest cetaceans and, in eastern Canada, few individuals exceed 1.7 m in total length. Like all phocoenids, harbour porpoises possess rounded heads that lack an external rostrum or beak. A small, triangular dorsal fin is located at approximately the mid-point of the back. The flanks are a mottled grayish white and fade to an almost white ventral surface. A black cape extends over the dorsal and lateral surfaces, although its extent varies considerably among individuals and populations.

Harbour porpoises are widely distributed over the continental shelves of the temperate Northern Hemisphere. In eastern Canada, the harbour porpoise occurs from the Bay of Fundy north to Cape Aston, at approximately 70° N. The southern range of the species extends to North Carolina. Harbour porpoises occur primarily over continental shelves, although individuals are occasionally found in deeper waters. The species, true to its name, is sometimes found in bays and harbours, particularly during the summer. There are no quantitative estimates of trends in the extent of habitat for harbour porpoises in eastern Canada.

Analyses of mitochondrial DNA, but not nuclear microsatellites, support the existence of three populations of harbour porpoises in eastern Canada: Newfoundland-Labrador, Gulf of St. Lawrence, and Bay of Fundy-Gulf of Maine.

Reproduction in all populations is seasonal, with ovulation and conception limited to a few weeks in early summer. Gestation lasts for 10-11 months followed by a lactation period of at least 8 months. Most mature female porpoises become pregnant each year. There have been no estimates of the annual survival rates of this species, but the species is relatively short-lived compared to other odontocetes and few individuals live past their teens.

In the Bay of Fundy, individual porpoises equipped with satellite-linked radio transmitters moved frequently between Canadian and U.S. waters. The population of porpoises in the Bay of Fundy and Gulf of Maine is trans-boundary in nature. The diet of harbour porpoises includes a variety of small fishes and cephalopods. At least some prey items are demersal, living on or near the sea floor; porpoises feeding on such items are at risk of entanglement in bottom-set gill nets.

There are no range-wide estimates of the abundance of harbour porpoises in eastern Canada, nor are there *any* estimates for the Newfoundland-Labrador population. Aerial line transect surveys in the Gulf of St. Lawrence during the summers of 1995 and 1996 provided estimates of 12,100 (CV = 0.26) and 21,720 (CV = 0.38) porpoises, respectively, although the results of these surveys are not directly comparable. Neither survey design allowed for correction of g(0), the probability of detecting an animal on the trackline; thus, both estimates are negatively biased. Aerial and shipboard line transect surveys were conducted during July-September in 1991, 1992, 1995 and 1999 in the Bay of Fundy and Gulf of Maine. All estimates were corrected for g(0). The most recent estimate of population size in the Bay of Fundy and Gulf of Maine was 89,700 (CV = 0.22).

The most important recent threat to harbour porpoises in eastern Canada is bycatch in bottom-set gill nets used to capture groundfish, such as cod (*Gadus morhua*). Substantial bycatches of harbour porpoises occurred in the past few decades in eastern Canada and the U.S. portion of the range of the Bay of Fundy-Gulf of Maine population. The magnitude of this threat has changed greatly in recent years due to the depletion of groundfish stocks and consequent reductions in fishing effort. Reliable estimates of these bycatches are available only for the Bay of Fundy-Gulf of Maine population. In the United States, annual bycatch mortality ranged from 2900 in 1990 to 79 in 2001; there has been a marked decrease during the past five years.

The harbour porpoise is protected from certain activities under the Marine Mammal Regulations of the *Fisheries Act of Canada*. These regulations do not, however, have any provisions to address the bycatch of marine mammals in commercial fisheries. The range of the harbour porpoise extends into United States waters of the Gulf of Maine, where the species is protected under the *Marine Mammal Protection Act*. Under this legislation, the maximum allowable annual removal limit for porpoises in the Bay of Fundy and Gulf of Maine is 747. Two Take Reduction Teams have been formed in the U.S. to address the bycatch of harbour porpoises from the Bay of Fundy-Gulf of Maine population. Both teams recommended measures to reduce the bycatches of harbour porpoises in the U.S. that include: times and areas completely closed to gill net fishing; times and areas in which acoustic alarms are required on groundfish gill nets; and a series of required modifications to the structure and use of groundfish gill nets.

In January, 1993 the U.S. government proposed listing the harbour porpoise population in the Bay of Fundy-Gulf of Maine as threatened under the *Endangered Species Act* because inadequate regulatory measures existed in Canada or the U.S. to address the bycatches of harbour porpoises. In January 1999, NMFS determined that the proposed listing was not warranted because bycatch reduction programs implemented in Canada and the U.S. were sufficient to ensure the population's sustainability. This conclusion was supported by a Population Viability Analysis. In August 2001, the U.S. government published its intention to remove this population from the candidate list under the *Endangered Species Act*. The harbour porpoise is classified as Vulnerable in the IUCN Red List and on Appendix 2 of CITES.

The relatively secure status of harbour porpoises in eastern Canada is due, in large part, to measures enacted not to conserve porpoises, but to restore groundfish stocks. It is likely that harbour porpoise bycatches will increase significantly if and when groundfish stocks recover in eastern Canada. The following scientific information is required, particularly for the populations in the Gulf of St. Lawrence and Newfoundland: unbiased estimates of abundance and bycatches, and an improved understanding of population structure. In addition, a policy framework is required to ensure that future bycatches do not exceed sustainable levels. There are no provisions to address bycatches under the Marine Mammal Regulations of the *Fisheries Act of Canada*. Nor is there any other mechanism for developing scientific advice regarding the sustainability of bycatch levels. The present respite in bycatch mortality provides a unique opportunity to formulate and implement such a mechanism.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.
** Formerly described as “Not In Any Category”, or “No Designation Required.”
*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list.

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

Update
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SPECIES INFORMATION

Name and classification

The accepted scientific name of the harbour porpoise is *Phocoena phocoena* (Linnaeus, 1758). The English and French common names are harbour porpoise and marsouin commun, respectively, although the species may be referred to as pourcil along the northern shore of the Gulf of St. Lawrence (Laurin 1976). Geographical variation in mitochondrial haplotype frequencies and cranial morphology supports the designation of several subspecies (Read 1999). The subspecies present along the Atlantic coast of Canada is *P. p. phocoena*; the subspecies present on the Pacific coast is *P. p. vomerina*.

Description

Harbour porpoises are among the smallest cetaceans and, in eastern Canada, few individuals exceed 1.7 m in total length. The species is sexually dimorphic. In the Bay of Fundy, females reach approximately 160 cm and 65 kg, compared to 145 cm and 50 kg for males (Read and Tolley 1997). A similar dimorphism is found in Newfoundland, where female porpoises reach asymptotic lengths and weights of 156 cm and 62 kg, respectively, while males attain asymptotic lengths and weights of 143 cm and 49 kg (Richardson 1992).

Like all phocoenids, harbour porpoises possess rounded heads that lack an external rostrum or beak. Their stocky bodies taper to a laterally flattened keel just anterior to the flukes. A small, triangular dorsal fin is located at approximately the mid-point of the back. The leading edge of the fin is lined with small, raised protuberances, known as tubercules. The relatively small, pointed flippers are located behind and below the angle of the mouth.

Koopman and Gaskin (1994) provide a detailed description of the pigmentation pattern of this species. A black cape extends over the dorsal and lateral surfaces, although its extent varies considerably among individuals and populations. The flanks are a mottled grayish white and fade to an almost white ventral surface. Individuals may exhibit dark eye, chin, and lip patches. Single or multiple dark stripes may extend from the angle of the mouth to the anterior insertion of the flippers.

Nationally significant populations

Not applicable.

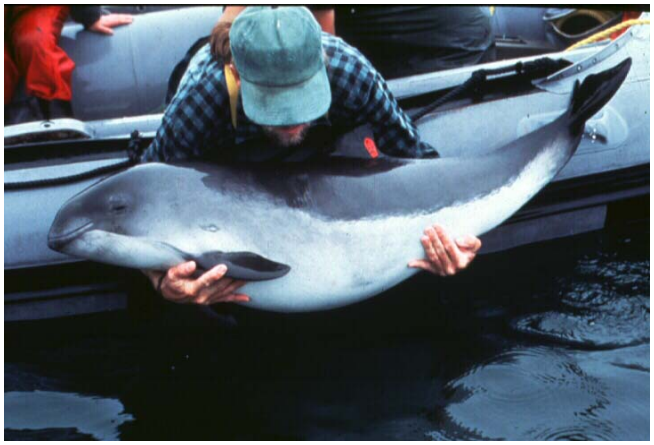

Figure 1. A harbour porpoise being released from a herring weir in the Bay of Fundy, Canada. Photo courtesy Grand Manan Whale and Seabird Research Station.

DISTRIBUTION

Global range

Harbour porpoises are widely distributed over the continental shelves of the temperate Northern Hemisphere (Gaskin 1984; IWC 1996). The species is found from the Barents Sea to Senegal in the eastern Atlantic; Upernavik, Greenland to Cape Hatteras (with occasional strandings in northern Florida) in the western Atlantic; the Mackenzie Delta to Monterey Bay, California in the eastern Pacific; and from Siberia to Wakayama, Japan in the western Pacific (Read 1999). An isolated sub-species, *P.p. relicta*, occurs in the Black Sea. Over the past few decades, harbour porpoises have largely disappeared from the English Channel and much of the Baltic Sea (IWC 1996), although the reasons for this disappearance are unknown.

Analysis of control region (d-loop) sequences of mitochondrial DNA indicates that harbour porpoises in the northwestern Atlantic are effectively isolated from those in the northeastern Atlantic (Rosel et al. 1999b; Tolley 2001) . Significant differences in DNA haplotype composition are maintained by the low level of dispersal, which is estimated to be 2.7 females per generation (Rosel et al. 1999b). Significant differences in mitochondrial haplotype frequencies and molecular diversity suggest a hiatus between Iceland and Norway, likely due to isolation caused by Pleistocene glaciation (Tolley 2001; Tolley et al. 2001).

Canadian range

In eastern Canada, the harbour porpoise occurs from the Bay of Fundy north to Cape Aston, Baffin Island, at approximately 70° N (Gaskin 1992). The southern range of the species extends into U.S. waters. Information on the distribution of this species is restricted largely to the summer months, when it is possible to conduct visual surveys for these small, cryptic animals (e.g. Palka 1995a). Additional information on

distribution has been obtained from observations of bycatches and strandings and, in the Bay of Fundy, from the movements of individual porpoises equipped with satellite-linked radio transmitters (Read and Westgate 1997).

Significant variation in sequence data from the control region of mitochondrial DNA (Rosel et al. 1999a) suggests the existence of three discrete populations in eastern Canada (Newfoundland-Labrador, Gulf of St. Lawrence, and Bay of Fundy-Gulf of Maine), and an adjacent population in West Greenland. In this analysis, the Gulf of Maine and Newfoundland populations both showed significant differentiation from the other two populations. However, porpoises from the Gulf of St. Lawrence and western Greenland could not be differentiated (Rosel et al. 1999a), although animals from these two areas have significantly different organochlorine contaminant profiles in their tissues (Westgate and Tolley 1999). The authors of the most recent molecular analysis (Tolley et al. 2001) suggest that these patterns may reflect historical biogeographical patterns rather than current ecological conditions. In particular, they note that harbour porpoises have only recently colonized northern areas following Pleistocene glaciation, and that insufficient time may have elapsed to allow significant differentiation in mitochondrial haplotype frequencies.

In contrast to the analysis of mitochondrial DNA, microsatellite markers exhibited little differentiation among these four populations (Rosel et al. 1999a). It is likely that male-mediated gene flow is sufficient to maintain homogeneity among nuclear markers, while female philopatry maintains genetic differences in the mitochondrial DNA (Wang et al. 1996). Similar findings have been made for Dall's porpoises *Phocoenoides dalli* in the North Pacific (Escorza-Treviño and Dizon 2000).

Some mixing of porpoises from the various populations occurs outside the breeding season. Analysis of mitochondrial haplotype frequencies suggests that individuals from all four populations in the northwestern Atlantic may strand during winter along the eastern coast of the United States (Rosel et al. 1999a). Haplotypes unique to the Gulf of St. Lawrence or West Greenland appeared in this sample of stranded animals and eight of the 28 haplotypes present were unique to the winter sample, suggesting that source populations have not been sampled with sufficient intensity to detect all of their diversity (Rosel et al. 1999a). For example, very limited sampling has occurred along the coast of Labrador or northern Newfoundland. Further work on the question of winter mixing is being conducted by Dr. Patty Rosel (U.S. National Oceanographic & Atmospheric Administration, Charleston, SC) and her students at the time of writing.

One mature female porpoise was tagged in the Bay of Fundy during early summer and was tracked as it moved to the Gulf of St. Lawrence (see below). This is the only porpoise (of 25 tracked) that left the range of the Bay of Fundy-Gulf of Maine population.

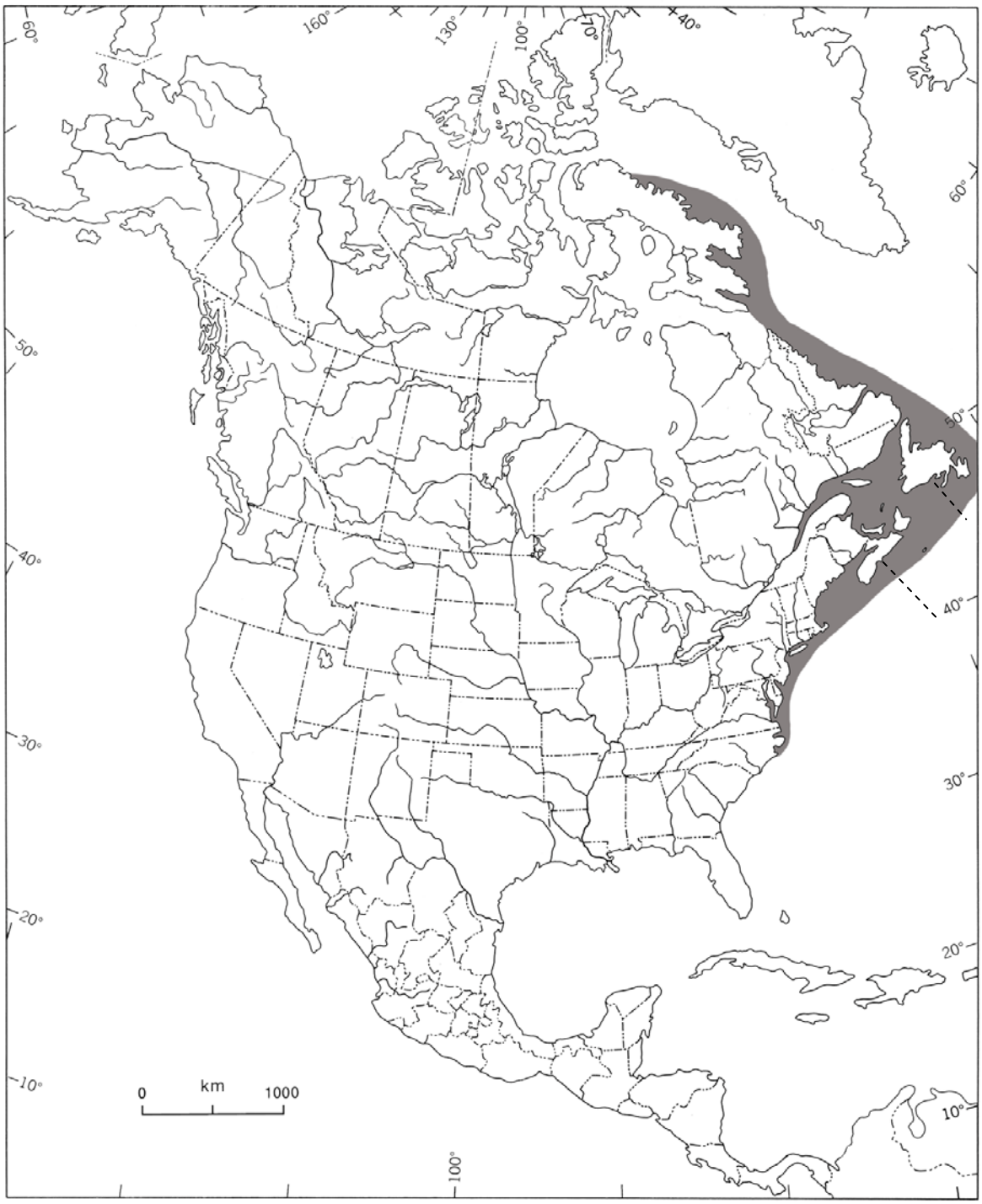

Figure 2. Distribution of harbour porpoises in eastern Canada. Map courtesy Dave Johnston, Duke University. Dashed lines indicate approximate delineations of the three populations.

Information on the distribution of the species in Newfoundland and Labrador is sparse, particularly compared to our knowledge of the species in more southern waters, and almost all information comes from the southeastern coast of Newfoundland. Nevertheless, observations of bycatches in groundfish gill nets made by Lien and colleagues (1994) and summarized in DFO (2001) show that porpoises are found around the entire island of Newfoundland (especially along the south coast, west coast and in Notre Dame Bay) as well as in southern Labrador. Bycatches of harbour porpoises were particularly common in parts of southeastern Newfoundland, such as St. Mary's Bay, during the early summer in the 1980s (*e.g.* Lien 1989). Stenson and Reddin (1990) reported bycatches in experimental salmon drift nets across the entire Grand Banks as well as along the continental shelf as far north as Nain. They also reported a number of catches in the Labrador Sea between Newfoundland and Greenland. With the exception of the Strait of Belle Isle and western coast of Newfoundland, no surveys have been conducted for this species in Newfoundland or Labrador.

During summer harbour porpoises are found throughout the Gulf of St. Lawrence, reaching upstream as far as the mouth of the Saguenay River. Porpoises are common along the north shore of the Gulf of St. Lawrence, along the Gaspé coast and in the Baie des Chaleurs (Fontaine et al. 1994; Kingsley and Reeves 1998). Densities of porpoises are lower in the southern Gulf of St. Lawrence.

In the Bay of Fundy and northern Gulf of Maine, the summer distribution of harbour porpoises is concentrated in waters less than 150 m deep, along the coasts of Maine and New Brunswick and extending to the southwestern tip of Nova Scotia (Waring et al. 2001). Porpoises equipped with satellite transmitters move back and forth frequently into and out of U.S. waters during the summer (Read and Westgate 1997). Densities are quite low in the upper reaches of the Bay of Fundy and along the southern shore of Nova Scotia (Gaskin 1992). There is considerable inter-annual variation in the summer distribution of this population (Palka 1995b).

In winter, many porpoises from the Bay of Fundy-Gulf of Maine population disperse into the Gulf of Maine and along the U.S. east coast as far south as North Carolina, where they may mix with individuals from more northern populations (Rosel et al. 1999a). Some porpoises may over-winter in the Bay of Fundy (Gaskin 1992; Westgate and Read, unpublished data). Very little is known of the winter distribution of the other two populations, although much of the Gulf of St. Lawrence is covered by ice during winter, so most porpoises must leave this area for open water.

No information exists on historical changes in occupancy of this species in eastern Canada.

HABITAT

Habitat Requirements

The habitat requirements of harbour porpoises were reviewed by Gaskin (1992). Harbour porpoises occur primarily over continental shelves, although individuals are occasionally found in deeper waters (Read and Westgate 1997; Waring et al. 2001). The species, true to its name, is sometimes found in bays and harbours, particularly during the summer. In the Bay of Fundy, harbour porpoises frequent areas in which physiographic features may help to concentrate prey or facilitate prey capture (Gaskin and Watson 1985; Watts and Gaskin 1985; Gaskin 1992). Porpoises are relatively small and have a limited ability to store energy (see below), so they must feed frequently and stay relatively close to prey patches. In the Bay of Fundy and Gulf of Maine, individual porpoises equipped with satellite transmitters used very large home ranges and moved rapidly between patches of suitable habitat separated by tens or even hundreds of kilometers (Read and Westgate 1997). Individual porpoises may use the same habitat in consecutive years (Watson 1976).

Trends

There are no quantitative estimates of trends in the extent of habitat for harbour porpoises in eastern Canada. Gaskin (1992) noted a decrease in the use of some inshore areas of the Bay of Fundy by harbour porpoises during the late 1970s. There are significant inter-annual changes in the distribution of this species in the Bay of Fundy and Gulf of Maine that confound attempts to document changes in patterns of habitat use or abundance. These changes appear to be related to the distribution and abundance of prey (Palka 1995b; Trippel et al. 1999).

Protection/ownership

Not applicable.

BIOLOGY

General

Compared to other cetaceans, this species has a relatively early age at sexual maturation and high fecundity (Read and Hohn 1995). Nevertheless, the limited lifespan and production of a single young per pregnancy impose constraints on the potential rate of increase (Caswell et al. 1998).

Reproduction

Most information on the life history of harbour porpoises in eastern Canada comes from research conducted on the relatively well-studied population in the Bay of Fundy

and Gulf of Maine (Fisher and Harrison 1970; Gaskin et al. 1984; Read 1990a; Read 1990b; Read and Gaskin 1990; Read and Hohn 1995). Richardson (1992) examined porpoises killed in bottom-set gill nets off eastern Newfoundland during the summer months and concluded that their reproductive biology was, in general, very similar to that in the Bay of Fundy. There are no published descriptions of the reproductive biology of female harbour porpoises from the Gulf of St. Lawrence.

Reproduction in all populations studied to date is seasonal, with ovulation and conception limited to a few weeks in the late spring or early summer (Börjesson and Read 2003). Gestation lasts for 10-11 months followed by a lactation period of at least 8 months. In many populations, most mature female porpoises become pregnant each year and thus spend most of their adult lives simultaneously pregnant and lactating (Read 1999). In the Bay of Fundy, for example, mean age at sexual maturation for female porpoises was estimated to be 3.44 years of age and the annual pregnancy rate was estimated to be 0.86 (Read 1990b; Read and Gaskin 1990). Estimates of age at sexual maturation (3.1 years) and pregnancy rate (0.76) were similar in Newfoundland (Richardson 1992). At birth, porpoise calves are approximately 75 cm long and weigh about 6 kg (Börjesson and Read 2003). While nursing, the calves grow rapidly and triple their body mass by 3 months of age (Read 2001), by which time they have started taking solid food (Smith and Read 1992).

Males exhibit pronounced seasonal variation in testicular size and activity, with peak sperm production occurring around the period of ovulation (Fontaine and Barrette 1997; Neimanis et al. 2000). The testes are large, reaching 4% of body mass during the peak breeding season, suggesting that male porpoises are sperm competitors (Fontaine and Barrette 1997). In Newfoundland, male porpoises matured at 3.0 years of age (Richardson 1992). In the Bay of Fundy, age at sexual maturation for male porpoises was estimated to be 2.6 years (Neimanis 1996).

Survival

There are no estimates of the annual survival rates of this species in any portion of its range. There are no data on survival of known individuals and samples of age distributions come primarily from strandings of dead animals or bycatches, both of which are known to be biased (Caswell et al. 1998). Nevertheless, it is clear that the species is relatively short-lived compared to other odontocetes and few individuals live past their teens (Richardson 1992; Read and Hohn 1995). The maximum reported lifespan is 24 years, derived from counts of dentinal growth layers in thin, decalcified and stained sections (Lockyer 1995).

Attempts to estimate the potential rate of increase have been thwarted by a lack of information on survival rates (Caswell et al. 1998). Estimates of the maximum potential rate of increase, derived using survival rates from a variety of other large mammals with similar life histories, ranged from 4% (Woodley and Read 1991) to 10% (Caswell et al. 1998), imposing considerable uncertainty in our understanding of the potential for populations to withstand anthropogenic sources of mortality.

Harbour porpoises are preyed on by white sharks (*Carcharodon carcharias*) (Arnold 1972) and killer whales (*Orcinus orca*) (Jefferson et al. 1991). There are no estimates of the numbers of porpoises consumed by these predators, nor are there estimates of the rates of natural mortality for any population. Furthermore, we know very little about the abundance or trends of abundance of these predators. Little is known about the role of disease in the natural mortality of harbour porpoises. Each spring, however, many emaciated, dead juveniles are found stranded along the U.S. east coast between New York and North Carolina, apparently having starved to death (Cox et al. 1998). In addition, in some parts of their range, harbour porpoises are killed by bottlenose dolphins *Tursiops truncatus* (Ross and Wilson 1996).

Physiology

The species is well adapted to cold water and is seldom found in water warmer than 16°C (Gaskin 1992). It maintains homeothermy in a cold, conductive environment using a variety of physiological and anatomical adaptations, including a 1.5-2 cm thick layer of lipid-rich blubber (Koopman 1998; Koopman et al. 2002; McLellan et al. 2002).

Movements/dispersal

Very little is known of the movements of harbour porpoises in Newfoundland or the Gulf of St. Lawrence. In the western Bay of Fundy, 25 individual porpoises were equipped with satellite-linked radio transmitters between 1994 and 2002 (Read and Westgate 1997; Westgate and Read 1998; Read and Westgate unpublished data), providing a large amount of information on the movement patterns of individuals in this population. These individuals have traveled more than 50 km in a single day and their home ranges could encompass the entire Gulf of Maine, an area of many thousands of km^2 (Read and Westgate 1997). The movements of these tagged porpoises varied considerably and no clear patterns were evident, other than a general tendency of porpoises to move southward into the Gulf of Maine during autumn.

Ten of 14 tagged porpoises monitored between 1994 and 1997 moved from Canadian to U.S. waters and two of these ten then returned to Canada in the same year before their tags ceased transmitting (Westgate and Read 1998). It is clear that the population of porpoises present in the Bay of Fundy and Gulf of Maine is trans-boundary in nature; management and conservation actions must take this fact into account. It should be possible to use these telemetry data, together with sightings data collected during abundance surveys, to calculate the proportion of this population present in the U.S. or Canada during the summer months; to date, however, this analysis has not been conducted.

One tagged individual, a pregnant and lactating female accompanied by a small dependent calf, was tagged in the Bay of Fundy during mid-July and traveled to the Gulf of St. Lawrence, where it spent the remainder of the summer. This was the only tagged individual to have left the range of the Bay of Fundy-Gulf of Maine population, as defined above. It was also tagged earlier (by approximately two weeks) than the other individuals.

Nutrition and interspecific interactions

Information on the diet of harbour porpoises comes almost exclusively from examination of prey remains in the stomachs of by-caught and dead, stranded animals. The diet includes a variety of small fishes and cephalopods, usually < 30 cm in length (Read 1999).

In Newfoundland, the diet of by-caught porpoises consisted mainly of small fish such as capelin, Atlantic herring, sand lance and horned lantern fish (G. Stenson, pers. comm.). In the Gulf of St. Lawrence, the diet of porpoises killed in groundfish gill nets was examined by Fontaine et al. (1994). Herring and capelin accounted for the majority of caloric intake; redfish, mackerel, cod, and squid were also consumed. There is significant regional variation in diet in both Newfoundland and the Gulf of St. Lawrence. In the latter area, capelin was the dominant prey in the northeastern Gulf but porpoises from the Gaspé region consumed mostly herring.

In the Bay of Fundy and Gulf of Maine, porpoises feed primarily, but not exclusively, on juvenile Atlantic herring of age classes 2, 3 and 4 (Recchia and Read 1989; Gannon et al. 1998). This primary prey item is augmented with juvenile gadids and other small groundfish. In the Bay of Fundy, porpoise calves begin to take solid food during the late summer by feeding on euphausiid crustaceans (Smith and Read 1992).

Due to their small size, and limited energy reserves, harbour porpoises have a limited capacity for fasting. The blubber is lipid-rich, but only part of this lipid store is available during times of food shortage (Koopman 2001; Koopman et al. 2002; McLellan et al. 2002). Consequently, individual porpoises must feed frequently to maintain body condition. This may also help explain the tight ecological association observed between this species and lipid-rich prey such as capelin and herring throughout eastern Canada.

The primary prey of harbour porpoises exhibits large fluctuations in abundance caused by natural recruitment cycles and the effects of commercial fisheries. In the Bay of Fundy and Gulf of Maine, the abundance of herring has varied widely over the past three decades, as stocks were overfished and subsequently recovered. Read (2001) examined the effects of this variation in prey biomass on the reproductive biology of female porpoises and particularly on the size of calves produced by females during these three decades. Surprisingly, female porpoises produced significantly larger calves during the decade (1980s) when prey biomass was lowest. There were no effects of variation in herring biomass on the body condition or fecundity of mature females during these three decades.

Behaviour/adaptability

Little is known about the behavior of harbour porpoises, in part because it is difficult to identify individuals in the field. Observations of a small number of naturally marked females in the Bay of Fundy indicated that their social groupings are fluid and

that individual porpoises may use the same areas in successive years (Watson 1976). Porpoises tagged together and equipped with satellite transmitters in the Bay of Fundy did not remain together after release (Read and Westgate 1997).

Harbour porpoises are usually observed in small groups of a few individuals, or alone, although larger aggregations of several hundred animals have been reported on occasion (Hoek 1992). Such large aggregations are temporary and likely driven by unusual concentrations of prey. As noted above, the mating system of this species likely involves sperm competition (Fontaine and Barrette 1997; Neimanis et al. 2000).

Harbour porpoises do not adapt readily to a captive environment and are seldom kept in oceanaria. Several live-stranded, rehabilitated juveniles, however, have been maintained for years in captivity and observations of these individuals have provided considerable insight into the biology of the species (Read et al. 1997). Some live-stranded juveniles have been released successfully after periods of rehabilitation that lasted for months or years (Westgate et al. 1998).

In general, harbour porpoises are shy animals, and intensive human activities in coastal waters may adversely affect their populations.

POPULATION SIZES AND TRENDS

There are no range-wide estimates of the abundance of harbour porpoises in eastern Canada and, in fact, much of the range of the species has never been surveyed. Surveys have been conducted for the Gulf of St. Lawrence and the Bay of Fundy-Gulf of Maine populations, but there are no estimates of abundance from Newfoundland or Labrador (DFO 2001).

Aerial line transect surveys were conducted for cetaceans in the Gulf of St. Lawrence during the summers of 1995 and 1996 by Kingsley and Reeves (1996). The 1995 survey was conducted in late August and early September and sampled most (69%) of the Gulf. The 1996 survey was conducted in late July and early August and focused on the shelf adjacent to the north shore of the Gulf, so the two surveys are not directly comparable in extent or timing. The estimates of abundance for the 1995 and 1996 surveys were 12,100 (CV = 0.26) and 21, 720 (CV = 0.38), respectively (Kingsley and Reeves 1996). The highest densities were observed in the northern Gulf and particularly along the north shore shelf. Neither survey design allowed for correction of g(0), the probability of detecting an animal on the survey trackline. Some porpoises were submerged when the survey plane passed and were unaccounted for and, thus, estimates of density derived from both surveys are negatively biased.

Four shipboard and aerial line transect surveys were conducted by the U.S. National Marine Fisheries Service to estimate abundance of harbour porpoises in the Bay of Fundy and Gulf of Maine (summarized in Waring et al. 2001). These surveys were conducted in July-September of 1991, 1992, 1995 and 1999 (Table 1). The

surveys conducted in 1991, 1992 and 1995 sampled the northern Gulf of Maine and lower Bay of Fundy; in 1999 survey coverage was expanded to include the entire Gulf of Maine, including northern Georges Bank, and the upper Bay of Fundy. In 1999, porpoises were seen in areas not surveyed during previous years. All estimates were corrected for g(0), the probability of detecting a group of porpoises on the survey trackline, using the direct-duplicate mark-recapture method (Palka 1995a). The shipboard components of all four surveys used two independent teams, searching with naked eyes in non-closing mode. This approach was used to correct for both perception and availability bias. The estimates of abundance resulting from these surveys are provided in Table 1.

The 1991 survey produced a much lower estimate of abundance than the other three surveys (Waring et al. 2001). This difference may have been due, in part at least, to inter-annual changes in porpoise distribution, caused by variation in water temperature and the distribution of prey (Palka 1995b).

Table 1. Estimates of harbour porpoise abundance in the Bay of Fundy and Gulf of Maine (data from Waring et al. 2001).

Year	Estimate of Abundance	CV	Abundance in Common Survey Area
1991	37,500	0.29	29,000
1992	67,500	0.23	57,600
1995	74,000	0.20	71,900
1999	89,700	0.22	67,600

All four surveys in the Bay of Fundy and Gulf of Maine covered a common area; the estimate of abundance for this area is presented in the last column of Table 1 (this estimate forms part of the total estimate of abundance). It is not possible to use these latter data to estimate a trend in abundance, however, because an unknown proportion of the population was outside this common survey area in all years (Waring et al. 2001). If, for example, more of the population was outside this common area (and perhaps in an unsurveyed area altogether) in 1991, it would not be appropriate to compare the results of this survey with those from more recent years. Thus, even for the best-studied population in eastern Canada we have no data on trends in abundance.

There are no estimates of the number of mature individuals in any population or the effective size of any population of harbour porpoise in eastern Canada, because of a lack of information on the true sex ratio or age structure of these populations (Caswell et al. 1998). Existing information on sex ratios and age structure have been obtained from samples of fisheries bycatches and strandings, which are unlikely to be representative of the populations from which they were derived.

LIMITING FACTORS AND THREATS

Archaeological examination of coastal middens indicates that porpoises were exploited by aboriginal peoples of eastern Canada prior to the arrival of Europeans, although the number of porpoise bones in these middens is quite small. Pinnipeds are much more commonly encountered in these archaeological excavations and were likely much more important in the diet of these people (D. Johnston, pers. comm.). Harbour porpoises were hunted by aboriginal people in parts of eastern Canada during the 19th and early 20th centuries (Leighton 1937). The number of animals taken was not recorded, but in the Bay of Fundy, several hundred porpoises were likely taken each year. Hunters worked from canoes on calm days, when it was possible to follow and approach porpoises; shotguns were used to wound or kill the animals. The blubber and mandibular fat pads were rendered for oil and the meat was used for human consumption (Leighton 1937). A small hunt by members of the Passamaquoddy tribe in Maine continued sporadically into the late 20th century, with the last animals taken in 1997 (Waring et al. 2001). Porpoises are still taken occasionally by aboriginal hunters in the northern part of their range in eastern Canada and by non-aboriginal residents of Newfoundland, Labrador and perhaps Quebec. For example, a 96-cm porpoise was shot by a hunter in Pangnirtung Fjord in October 1988 (D. Pike, pers. comm.).

The most important recent threat to harbour porpoises in eastern Canada is bycatch in commercial fisheries. Most of this bycatch occurs in bottom-set gill nets used to capture groundfish, such as cod (*Gadus morhua*); this bycatch has existed since gill nets were first introduced into North American fisheries in 1880 by Spencer Baird, then United States Commissioner of Fish and Fisheries. In the first report of the efficacy of these nets, Collins (1886) noted that "…in addition to the various species of Gadidae which have been taken, porpoises (locally called "puffers")…have been caught…"

Substantial bycatches of harbour porpoises occurred in the past few decades throughout eastern Canada and in the U.S. portion of the range of the Bay of Fundy-Gulf of Maine population. The magnitude of this threat has changed considerably in recent years in eastern Canada and the Gulf of Maine because of the depletion of groundfish stocks and subsequent reductions in fishing effort.

Large bycatches of harbour porpoises occurred in Newfoundland and Labrador during the 1970s and 1980s. Dr. Jon Lien (in DFO 2001) has reviewed available estimates of the magnitude of these bycatches, generated primarily from phone surveys and logbooks. Most estimates of total bycatch extrapolated from these surveys were in the low thousands each year. As noted by Dr. Lien, however, "Asking fishermen for numbers of animals incidentally captured and adding them up does not necessarily make good estimates." Nevertheless, it is clear that harbour porpoises were a common bycatch in Newfoundland and Labrador during this period, primarily in groundfish gill nets.

Patterns of groundfish gill net fishing effort changed dramatically after the moratorium on fishing for NAFO Subdivision 2J3KL cod in 1992 and other subsequent

groundfish closures, although the actual effects of these changes in fishing practices on porpoise bycatches have not been documented. A significant gill net fishery still exists for lumpfish (*Cyclopterus lumpus*), in which approximately 15,000 harp seals (*Phoca groenlandica*) have been taken per year since 1994 (Walsh et al. 2001). This fishery is known to take harbour porpoises, although there are no published estimates of the magnitude of this bycatch. Logbook data exist from the past decade, and it may be possible to use these data to derive an approximate estimate of the annual bycatch mortality of harbour porpoises in this fishery (B. Sjare, pers. comm.). Porpoises are also taken in sentinel groundfish gill net fisheries in Newfoundland and Labrador (designed to monitor depleted cod stocks); 32 porpoises were reported taken by 19 sentinel fishermen in this program during 2002 (J. Lawson, pers. comm.). Co-operative research between DFO and Memorial University documented 7 confirmed and 20 probable bycatches of harbour porpoises from 33 additional gill net and trap fishermen who participated in the Bycatch Collector Program in Newfoundland during 2002 (J. Lawson, pers. comm). Extrapolations of these sparse data to all fisheries yields a rough estimate of several thousand porpoises taken as bycatch in 2002. As with past bycatch information from this population, most current information comes from the south coast of Newfoundland.

Information on bycatches of harbour porpoises in the Gulf of St. Lawrence comes from survey questionnaires mailed to fishermen in 1989, 1990 and 1994 (Fontaine et al. 1994; Larrivée 1996; DFO 2001). Crude extrapolation from these surveys to the entire fishery resulted in estimates that ranged from 2,000 to 4,000 porpoises per year. The same caveats noted for Newfoundland hold here, too, and these numbers should not be viewed as reliable historical estimates of the total bycatch of harbour porpoises in the Gulf of St. Lawrence. Most bycatches occurred during summer in groundfish gill nets set along the lower north shore and along the coasts of the Gaspé and Baie des Chaleurs (Fontaine et al. 1994). As in Newfoundland, there has been considerable change recently in the commercial fisheries in the Gulf of St. Lawrence, with large scale failures of groundfish stocks and subsequent fisheries closures. The effects of these reductions in fishing effort on porpoise bycatches have not yet been quantified (DFO 2001), although data for several fisheries have been collected through an at-sea observer program during the last decade. Analysis of these data, together with the results of more questionnaire surveys, is currently underway (V. Lesage, pers. comm.).

Bycatches of harbour porpoises in commercial fisheries in the Bay of Fundy have been documented since the early 1980s (Gaskin 1984; Read and Gaskin 1988). As in other areas of eastern Canada, the largest bycatches occur in groundfish gill net fisheries. The magnitude of this bycatch was estimated in recent years, by DFO in Canada and in the U.S. by the National Marine Fisheries Service. These agencies place independent observers aboard a sample of fishing vessels, so that a bycatch rate can be estimated. This bycatch rate is then extrapolated to the entire fishery using some metric of total fishing effort (see Bravington and Bisack 1996; Bisack 1997; Trippel et al. 1996; and Waring et al. 2001 for more details). Estimates of harbour porpoise bycatches generated for the Bay of Fundy, Gulf of Maine and Mid-Atlantic States are presented in Table 2. All of these bycatches from the Bay of Fundy and Gulf

of Maine and the majority of bycatches from the Mid-Atlantic are believed to have been taken from the Bay of Fundy-Gulf of Maine harbour porpoise population (Table 2).

As in Newfoundland and the Gulf of St. Lawrence, there have been profound changes in fishing effort in the groundfish gill net fishery in the range of this southern population. In the Bay of Fundy, a variety of fisheries conservation measures have been used to reduce fishing mortality on cod and other groundfish, including temporal fishery closures. In 1995, a *Harbour Porpoise Conservation Strategy for the Bay of Fundy* was implemented by DFO. Under this strategy, a cap of 110 by-caught harbour porpoises per year was set for the Bay of Fundy, after which the fishery would be closed. Time-area fishery closures have been used as a fisheries conservation measure in the Gulf of Maine, together with a host of other tools designed to conserve overfished stocks of cod and other groundfish. These measures have significantly reduced fishing effort in both Canadian and U.S. fisheries. In addition, in U.S. waters of the Gulf of Maine and Mid-Atlantic states, harbour porpoise bycatches are now regulated under two Take Reduction Plans (see below). Taken together, all of these conservation measures have significantly reduced the bycatches of harbour porpoises from the Bay of Fundy-Gulf of Maine population over the past few years.

Table 2. Estimates of harbour porpoise bycatches (with CVs in parentheses, where available) in groundfish gill net fisheries in the Bay of Fundy, Gulf of Maine and Mid-Atlantic States. Data are taken from Bravington and Bisack (1996), Bisack (1997), Trippel et al. (1996) and Waring et al. (2001) and E. Trippel (pers. comm). Data are not available (N/A) prior to 1993 for the Bay of Fundy or 1995 for the Mid-Atlantic. Totals are only provided for years in which estimates are available for all three areas.

Year	Bay of Fundy	Gulf of Maine	Mid-Atlantic	Total
1990	N/A	2900 (0.32)	N/A	-
1991	N/A	2000 (0.35)	N/A	-
1992	N/A	1200 (0.21)	N/A	-
1993	424	1400 (0.18)	N/A	-
1994	101	2100 (0.18)	N/A	-
1995	87	1400 (0.27)	103 (0.57)	1590
1996	20	1200 (0.25)	311 (0.31)	1531
1997	43	782 (0.22)	572 (0.35)	1397
1998	38	332 (0.46)	446 (0.36)	816
1999	32	270 (0.28)	53 (0.49)	355
2000	28	507 (0.37)	21 (0.76)	536
2001	73	53 (0.97)	26 (0.95)	152

Small numbers of harbour porpoises are taken in other fisheries throughout eastern Canada, including surface drift net fisheries for herring and mackerel and weir fisheries for herring, particularly in the Bay of Fundy. Mortality in the latter fishery has been reduced to a few porpoises each year because of a co-operative program run by biologists and fishermen on Grand Manan Island, New Brunswick.

Other potential threats to the species include loss of habitat due to the use of Acoustic Harassment Devices (AHDs) around salmon mariculture sites in the Bay of Fundy (Strong et al. 1995). Concern has been expressed regarding the proliferation of high amplitude acoustic harassment devices (AHDs) used to deter pinnipeds from approaching salmon mariculture sites in the Bay of Fundy and elsewhere (Taylor et al. 1997). These devices produce high intensity sounds at frequencies within the hearing range of harbour porpoises. During experiments conducted in the Bay of Fundy, no porpoises approached within 645 m of an active, commercial AHD and porpoise densities were reduced significantly in its vicinity (Johnston 2002). Experiments with AHDs and harbour porpoises in British Columbia demonstrated similar results (Olesiuk et al. In Press), and reductions in the occurrence of other odontocete cetaceans in the vicinity of active AHDs have also been documented (Morton 2000, Morton and Symonds 2002) These devices are used widely in the rapidly growing mariculture industry in the Bay of Fundy (Johnston and Woodley 1998), and there is potential for habitat exclusion of harbour porpoises on a large scale in this region.

In the past, concern was expressed over the level of anthropogenic organochlorine contamination (OCs) in harbour porpoises (*e.g.* Gaskin 1992). Recent data exist on OC loads in all three populations in eastern Canada (Westgate et al. 1997). Polychlorinated biphenyls (PCBs) and chlorinated bornanes are the dominant contaminants in all populations. Generally, concentrations of OC contaminants increase in a north to south gradient with porpoises in the Bay of Fundy and Gulf of Maine exhibiting the highest levels. Westgate et al. (1997) also reported that levels of PCBs and dichloro-diphenyl-trichloroethanes (DDTs) had decreased significantly from those documented by Gaskin et al. (1971, 1976, 1983). Recent concentrations of OCs are similar to contemporary levels reported in other harbour porpoise populations (Westgate et al. 1997). It is still unclear what proximate or ultimate effects these OC burdens have on harbour porpoises. The harbour porpoise is one of the indicator species used by the IWC Scientific Committee in its “Pollution 2000+” programme, which is designed to provide information on the effects of pollutants on the health of cetaceans. Results of this programme are not yet available.

Habitat degradation and loss caused by petroleum exploration and production is a potential threat in several areas of the range of this species in eastern Canada, especially in parts of the Gulf of St. Lawrence and along the Scotian Shelf. Acoustic harassment or displacement could occur during seismic exploration, particularly if such activities occur relatively close to shore, in preferred feeding areas, or within migration corridors. There have been no studies of the effects of these activities on harbour porpoises.

Finally, the primary prey species of harbour porpoises, particularly herring are exploited by commercial fisheries throughout eastern Canada; thus, the potential exists

for depletion of these prey resources through overfishing. At this time however, there is no evidence that the population biology of any harbour porpoise population has been affected by fishing for prey.

SPECIAL SIGNIFICANCE OF THE SPECIES

Neither the species nor the subspecies are endemic to eastern Canada. The species is likely to be an important upper trophic level predator, but its exact ecological role is poorly understood and there have been no natural or designed removal experiments to address this question. The species is not monotypic; there are three other species in the genus (Burmeister's porpoise Phocoena spinipinnis, vaquita Phocoena sinus and spectacled porpoise Phocoena dioptrica). The harbour porpoise is at risk throughout its range (see IUCN Red List Status below), primarily as a result of bycatches in fisheries. This is also true for the Burmeister's porpoise and, particularly, for the vaquita which is classified as Critically Endangered by the IUCN because of low abundance and continued bycatches in the Gulf of California.

In many areas, the species is an minor, ancillary attraction to an expanding whale-watching tourism industry (Lien 2001). The harbour porpoise is one of the best-studied cetacean species in eastern Canada, thanks primarily to the pioneering research efforts of the late Dr. David Gaskin of the University of Guelph, who died in 1998.

EXISTING PROTECTION OR OTHER STATUS

Management of the harbour porpoise, like other marine mammals, falls under the Marine Mammal Regulations (SOR/93-56) of the *Fisheries Act of Canada*. These regulations do not, however, have any provisions to address the bycatch of marine mammals in commercial fisheries, the primary threat to harbour porpoises in eastern Canada. Experiments have been conducted in the Bay of Fundy to develop mitigation measures, such as the use of acoustic alarms, or pingers (Trippel et al. 1999; Cox et al. 2001) and acoustically modified gill nets (Trippel et al. 2003). To date, however, none of these measures have been implemented in any gill net fishery in eastern Canada. The primary protective measures for harbour porpoises in eastern Canada are limitations on gill net fishing effort designed to conserve groundfish stocks in the Bay of Fundy, Gulf of St. Lawrence and Newfoundland.

In October 1994, DFO released a *Draft Harbour Porpoise Conservation Plan for the Bay of Fundy*. The intent of this plan was to "assist the present population of harbour porpoises in the Bay of Fundy/Gulf of Maine to grow to a level where the occasional take by fishing operations will not seriously influence the sustainability of the population." To achieve this goal, several measures were to be taken, including holding consultations with the fishing industry and U.S. regulatory agencies. The Plan sets a cap of 110 harbour porpoises per year from the Canadian portion of its range (*i.e*., the Bay of Fundy). Implementation of the Plan by DFO involved within-season monitoring

of porpoise bycatch (through an independent bycatch program) and commercial fishing effort data (gillnet vessel day trips). Fishermen were instructed through annual pre-season consultative meetings that if the bycatch was expected to exceed 110 animals the fishery would be closed for the remainder of the season. The final DFO *Harbour Porpoise Conservation Strategy* for the Bay of Fundy was signed by the Regional Director General (Maritimes Region) in November 1995. Reviewers of the current document have indicated that this strategy is still in place.

The range of the harbour porpoises in eastern Canada extends into the United States, where the species is protected under the *Marine Mammal Protection Act* (MMPA) of 1972. The maximum allowable annual removal limit for each stock of marine mammals in the U.S. is referred to as the potential biological removal level, or PBR (Wade 1998b; Read and Wade 2001). The current PBR for harbour porpoises in the Bay of Fundy and Gulf of Maine is 747 (Waring et al. 2001). Marine mammal stocks for which anthropogenic mortality exceeds PBR are designated as strategic. Once a stock is declared strategic, management actions must be formulated to reduce levels of mortality and serious injury to below PBR. Typically, a Take Reduction Team is formed to address situations in which bycatches exceed PBR. These Teams are comprised of representatives of stakeholder groups, including fishermen, scientists, conservation groups and managers, who negotiate a plan to reduce the magnitude of anthropogenic mortality to below PBR within a specified period (see Bache (2001) and Young (2001) for a more detailed description).

Two Take Reduction Teams (TRTs) have been formed in the United States to address the bycatch of harbour porpoises from the Bay of Fundy-Gulf of Maine population in commercial fisheries: the Gulf of Maine Harbour Porpoise TRT (formed in February 1996) and the Mid-Atlantic Harbour Porpoise TRT (formed in February 1997). Both teams recommended measures to reduce the bycatches of harbour porpoises in commercial fisheries. These measures were published together as the *Harbor Porpoise Take Reduction Plan Regulations* by the National Marine Fisheries Service (NMFS) in December 1998 (see http://www.nero.nmfs.gov/porptrp/). These regulations combine a complex mix of measures, including: times and areas completely closed to gill net fishing for groundfish; times and areas in which acoustic alarms (or 'pingers') are required on groundfish gill nets (Kraus et al. 1997); and a series of required modifications to the structure and use of groundfish gill nets.

It is clear (Table 2) that harbour porpoise bycatches were decreasing for some time prior to the implementation of these regulations in 1998. Part of this reduction was due to conservation measures designed to reduce porpoise bycatches implemented by the New England Fisheries Management Council as early as 1994. These measures included closures to all groundfish gill net fishing in certain parts of the Gulf of Maine (Murray et al. 2000). During this period, significant changes were occurring in the gill net fishery because of fisheries management measures designed to conserve depleted stocks of groundfish in the Gulf of Maine and Mid-Atlantic States. The most recent estimates of bycatch for this population (528 in 2000) are below the current PBR level (747). The Bay of Fundy-Gulf of Maine population of harbour porpoises is still considered strategic under the MMPA, because "average annual fishery-related

mortality and serious injury exceeded PBR for many years before 1999 and the takes have been below PBR for only one year" (Waring et al. 2001).

In January, 1993 NMFS proposed listing the harbour porpoise population in the Bay of Fundy-Gulf of Maine as a threatened species under the United States *Endangered Species Act* (NMFS 1993). This listing was proposed because inadequate regulatory measures existed in Canada and the United States to address the bycatches of harbour porpoises in commercial fisheries. Action on this proposal was deferred for several years as the New England Fisheries Management Council and the two Take Reduction Teams developed strategies to reduce the bycatch of porpoises in gill net fisheries. In January 1999, NMFS determined that the proposed listing was not warranted because the bycatch reduction programs implemented in Canada and the United States were sufficient to reverse any decline in abundance and ensure the population's sustainability (NMFS 1999). As part of this determination, Wade (1998a) conducted a Population Viability Analysis (PVA) of the Bay of Fundy-Gulf of Maine harbour porpoise population. Using abundance data from 1991-1995 and bycatch data from 1992-1996 (see Tables 1 and 2), Wade estimated a low overall probability of extinction in 20 years (<0.005), but a high (0.28-0.72) overall probability of extinction within 100 years. Reducing the bycatch to one-quarter of the 1992-1996 levels eliminated the risk of extinction within 20 years and made the overall risk of extinction within 100 years very low (0.00-0.01). The 1999 estimate of abundance was considerably larger than the 1991-1995 estimates (Table 1) and bycatches in 1999 were less than one-quarter of the mean value from 1992-1996 (Table 2). In August 2001, NMFS published its intention to remove this population from the candidate list under the *Endangered Species Act* (NMFS 2001).

The harbour porpoise is classified as Vulnerable in the IUCN Red List due to suspected reductions in its extent of occurrence and quality of habitat, and because of high levels of bycatch throughout much of its range (http://www.redlist.org/).

SUMMARY OF STATUS REPORT

In all areas of the range of this species, the most serious threat is posed by incidental mortality (bycatches) in commercial fisheries. The bycatches have occurred primarily in gill net fisheries for groundfish, although their magnitude has diminished in recent years, primarily because of conservation measures designed to promote the recovery of fish stocks (although see below). Additional potential threats to the species come from anthropogenic modification of habitat, although the magnitude of this threat will have less direct impact than bycatch mortality.

Current knowledge is insufficient to determine the status of harbour porpoises in Newfoundland, Labrador and the Gulf of St. Lawrence; there are no estimates of total abundance or bycatch mortality from either area, although partial estimates of abundance have been generated for the Gulf of St. Lawrence.

Most information on this species in eastern Canada pertains to the southern-most population in the Bay of Fundy. A current estimate of abundance and a decade-long time series of bycatch estimates are available for this population. Several past estimates of abundance are available, but these surveys did not cover comparable areas, so it is not possible to derive a trend in abundance. Over the past decade, large bycatches (numbering in the thousands) occurred in the U.S. and Canadian ranges of this population. These catches spurred several management initiatives, primarily in U.S. waters, to reduce bycatches to sustainable levels. And, as noted above, additional important conservation benefits were derived from management measures designed to promote the recovery of depleted stocks of groundfish in the Bay of Fundy and Gulf of Maine. Current bycatch levels are less than the allowable limits under the U.S. *Marine Mammal Protection Act* and have been reduced to the extent that the Bay of Fundy-Gulf of Maine population has been removed from the list of candidate species under the U.S. *Endangered Species Act*. A recent PVA indicates that the current levels of bycatch pose little or no threat to the future viability of this population.

It is important to note that the current conservation status of harbour porpoises in the Bay of Fundy and Gulf of Maine (and perhaps elsewhere in eastern Canada) is due, in large part, to conservation measures enacted not to conserve porpoises, but to restore groundfish stocks. Harbour porpoise bycatches will increase significantly if and when groundfish stocks recover and gill net fisheries expand in eastern Canada. Management measures exist under U.S. legislation to ensure that future bycatches in U.S. fisheries should not endanger the Bay of Fundy-Gulf of Maine population, but no similar measures exist in Canadian law.

To ensure that future bycatches do not threaten harbour porpoises in eastern Canada, the following scientific information is required, particularly for the Gulf of St. Lawrence and Newfoundland-Labrador:

1. Unbiased estimates of abundance;
2. Unbiased estimates of the magnitude of bycatch, from an independent observer program; and
3. Improved understanding of population structure and dispersal rates.

In addition, a policy framework and management scheme are required to ensure that future bycatches do not exceed sustainable levels. At the present time, there are no provisions to address bycatches under the Marine Mammal Regulations of the Fisheries Act of Canada, nor is there any mechanism in Canada for generating advice on what levels of bycatch mortality are likely to be sustainable. Several potentially useful policy models are available, however, such as the PBR scheme in the United States (Read and Wade 2001), the advice provided by the Scientific Committee of the International Whaling Commission (IWC 1996) or the guidelines used by the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (IWC 2000). The present respite in bycatch mortality provides a unique opportunity to formulate and implement such a policy, at little or no cost.

TECHNICAL SUMMARY

Phocoena phocoena
Harbour porpoise — Marsouin commun
Northwest Atlantic population

Extent and Area information	
• *extent of occurrence (EO)(km²)*	~Unknown (> 150,000 km²)
• *specify trend (decline, stable, increasing, unknown)*	Unknown
• *are there extreme fluctuations in EO (> 1 order of magnitude)?*	No
• *area of occupancy (AO) (km²)*	Unknown (>~ 150,000 km²)
• *specify trend (decline, stable, increasing, unknown)*	Unknown
• *are there extreme fluctuations in AO (> 1 order of magnitude)?*	No
• *number of extant locations*	N/A
• *specify trend in # locations (decline, stable, increasing, unknown)*	N/A
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	N/A
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	Declining
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	*ca* 7 years
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	> 50,000
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	Unknown
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	
• *are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?*	No
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?*	No
• *list each population and the number of mature individuals in each.*	N/A
• *specify trend in number of populations (decline, stable, increasing, unknown).*	N/A
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	No
Threats (actual or imminent threats to populations or habitats) [add rows as needed]	
- Bycatches in commercial fisheries - Habitat degradation and loss caused by acoustic harassment devices - Habitat degradation and loss caused by other human activities	
Rescue Effect (immigration from an outside source)	Low
• *does species exist elsewhere (in Canada or outside)?*	Yes
• *status of the outside population(s)?*	Unknown
• *is immigration known or possible?*	Possible but likely rare
• *would immigrants be adapted to survive here?*	Yes
• *is there sufficient habitat for immigrants here?*	Likely
Quantitative Analysis	**Yes**

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