NORTH ATLANTIC RIGHT WHALE (*Eubalaena glacialis*): Western Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The western North Atlantic right whale population ranges primarily from calving grounds in coastal waters of the southeastern United States to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence. Knowlton *et al.* (1992) reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland. In addition, recent resightings of photographically identified individuals have been made off Iceland, in the old Cape Farewell whaling ground east of Greenland (Hamilton *et al.* 2007), northern Norway (Jacobsen *et al.* 2004), and the Azores (Hamilton *et al.* 2009). The September 1999 Norwegian sighting represents one of only two published sightings this century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described. The few published records from the Gulf of Mexico (Moore and Clark 1963; Schmidly *et al.* 1972) represent either distributional anomalies, normal wanderings of occasional animals, or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern United States. Whatever the case, the location of much of the population is unknown during the winter. Offshore (greater than 30 miles) surveys flown off the coast of northeastern Florida and southeastern Georgia from 1996 to 2001 had 3 sightings in 1996, 1 in 1997, 13 in 1998, 6 in 1999, 11 in 2000 and 6 in 2001 (within each year, some were repeat sightings of previously recorded individuals). Several of the years that offshore surveys were flown were some of the lowest count years for calves and for numbers of right whales in the Southeast recorded since comprehensive surveys began in the calving grounds. Therefore, the frequency with which right whales occur in offshore waters in the southeastern U.S. remains unclear.

Research results suggest the existence of six major habitats or congregation areas for western North Atlantic right whales: the coastal waters of the southeastern United States; the Great South Channel; Georges Bank/Gulf of Maine; Cape Cod and Massachusetts Bays; the Bay of Fundy; and the Scotian Shelf. However, movements within and between habitats are extensive. In 2000, one whale was photographed in Florida waters on 12 January, then again eleven days later (23 January) in Cape Cod Bay, less than a month later off Georgia (16 February), and back in Cape Cod Bay on 23 March, effectively making the round-trip migration to the Southeast and back at least twice during the winter season (Brown and Marx 2000). Results from satellite tags clearly indicate that sightings separated by perhaps two weeks should not necessarily be assumed to indicate a stationary or resident animal. Instead, telemetry data have shown rather lengthy and somewhat distant excursions, including into deep water off the continental shelf (Mate *et al.* 1997; Baumgartner and Mate 2005). Systematic surveys conducted off the coast of North Carolina during the winters of 2001 and 2002 sighted 8 calves, suggesting the calving grounds may extend as far north as Cape Fear. Four of the calves were not sighted by surveys conducted further south. One of the cows photographed was new to researchers, having effectively eluded identification over the period of its maturation (McLellan *et al.* 2004).

New England waters are an important feeding habitat for right whales, which feed in this area primarily on copepods (largely of the genera *Calanus* and *Pseudocalanus*). Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitats (Kenney *et al.* 1986, 1995). While feeding in the coastal waters off Massachusetts has been better studied than in other areas, right whale feeding has also been observed on the margins of Georges Bank, in the Great South Channel, in the Gulf of Maine, in the Bay of Fundy, and over the Scotian Shelf. The characteristics of acceptable prey distribution in these areas are beginning to emerge (Baumgartner *et al.* 2003; Baumgartner and Mate 2003). NMFS (National Marine Fisheries Service) and Provincetown Center for Coastal Studies aerial surveys during springs of 1999-2006 found right whales along the Northern Edge of Georges Bank, in the Great South Channel, in Georges Basin, and in various locations in the Gulf of Maine including Cashes Ledge, Platts Bank, and Wilkinson Basin. Analyses of the sightings data has shown that utilization of these areas has a strong seasonal component (Pace and Merrick 2008). The consistency with which right whales occur in such locations is relatively high, but these studies also highlight the high interannual variability in right whale use of some habitats.

Genetic analyses based upon direct sequencing of mitochondrial DNA (mtDNA) have identified ~~five~~ six mtDNA haplotypes in the western North Atlantic right whale (Malik *et al.* 1999, McLeod and White 2010). Schaeff *et al.* (1997) compared the genetic variability of North Atlantic and southern right whales (*E. australis*), and found the former to be significantly less diverse, a finding broadly replicated by Malik *et al.* (2000). The low diversity in North Atlantic right whales might be indicative of inbreeding, but no definitive conclusion can be reached using current data. Additional work comparing modern and historic genetic population structure, using DNA extracted from museum and archaeological specimens of baleen and bone, has suggested that the eastern and western North Atlantic populations were not genetically distinct (Rosenbaum *et al.* 1997; 2000). However, the virtual extirpation of the eastern stock and its lack of recovery in the last hundred years strongly suggests population subdivision over a protracted (but not evolutionary) timescale. Genetic studies concluded that the principal loss of genetic diversity occurred prior to the 18th century (Waldick *et al.* 2002). However, revised conclusions that nearly all the remains in the North American Basque whaling archaeological sites were ~~Bowhead~~ bowhead whales and not right whales (Rastogi *et al.* 2004) contradict the previously held belief that Basque whaling during the 16th and 17th centuries was principally responsible for the loss of genetic diversity.

High-resolution (using 35 microsatellite loci) genetic profiling has been completed for 66% of all identified North Atlantic right whales through 2001. This work has improved our understanding of genetic variability, number of reproductively active individuals, reproductive fitness, parentage and relatedness of individuals (Frasier *et al.* 2007).

One emerging result of the genetic studies is the importance of obtaining biopsy samples from calves on the calving grounds. Only 60% of all known calves are seen with their mothers in summering areas, when their callosity patterns are stable enough to reliably make a photo-ID match later in life. The remaining 40% are not seen on a known summering ground. Because the calf's genetic profile is the only reliable way to establish parentage, if the calf is not sampled when associated with its mother early on, then it is not possible to link it with a calving event or to its mother, and information such as age and familial relationships is lost. From 1980 to 2001, there were 64 calves born that were not sighted later with their mothers and thus unavailable to provide age-specific mortality information (Frasier *et al.* 2007). An additional interpretation of paternity analyses is that the population size may be larger than was previously thought. Fathers for only 45% of known calves have been genetically determined. However, genetic profiles were available for 69% of all photo-identified males (Frasier 2005). The conclusion was that the majority of these calves must have different fathers ~~which~~ that cannot be accounted for by the unsampled males and the population of males must be larger (Frasier 2005). This inference of additional animals that have never been captured photographically and/or genetically suggests the existence of habitats of potentially significant use that remain unknown.

POPULATION SIZE

The western North Atlantic minimum stock size is based on a census of individual whales identified using photo-identification techniques. A review of the photo-ID recapture database as it existed on ~~24~~ 6 ~~June~~ July ~~2009~~ 2010 indicated that ~~361~~ 396 individually recognized whales in the catalog were known to be alive during ~~2005~~2007. This number represents a minimum population size. This count has no associated coefficient of variation.

Previous estimates using the same method with the added assumption that whales seen within the previous seven years were still alive have resulted in counts of 295 animals in 1992 (Knowlton *et al.* 1994) and 299 animals in 1998 (Kraus *et al.* 2001). An IWC workshop on status and trends of western North Atlantic right whales gave a minimum direct-count estimate of 263 right whales alive in 1996 and noted that the true population was unlikely to be substantially greater than this (Best *et al.* 2001).

Historical Abundance

An estimate of pre-exploitation population size is not available. Basque whalers were thought to have taken right whales during the 1500s in the Strait of Belle Isle region (Aguilar 1986), however, recent genetic analysis has shown that nearly all of the remains found in that area are, in fact, those of bowhead whales (Rastogi *et al.* 2004; Frasier *et al.* 2007). The stock of right whales may have already been substantially reduced by the time whaling was begun by colonists in the Plymouth area in the 1600s (Reeves *et al.* 2001; Reeves *et al.* 2007). A modest but persistent whaling effort along the coast of the eastern U.S. lasted three centuries, and the records include one report of 29 whales killed in Cape Cod Bay in a single day during January 1700. Based on incomplete historical whaling data, Reeves and Mitchell could conclude only that there were at least hundreds of right whales present in the western North Atlantic during the late 1600s. Reeves *et al.* (1992) plotted a series of population trajectories using historical data, assuming a ~~present~~ present-day population size of 350 animals. The results suggested that there may have been at least 1,000 right whales in the population during the early to mid-1600s, with the greatest population decline occurring in the early 1700s. The authors cautioned, however, that the record of removals is incomplete, the results were preliminary, and refinements are required. Based on back calculations using the present population size and growth rate, the population may have numbered fewer than 100 individuals by 1935 when international protection for right whales came into effect (Hain 1975; Reeves *et al.* 1992; Kenney *et al.* 1995). However, little is known about the population dynamics of right whales in the intervening years.

Minimum Population Estimate

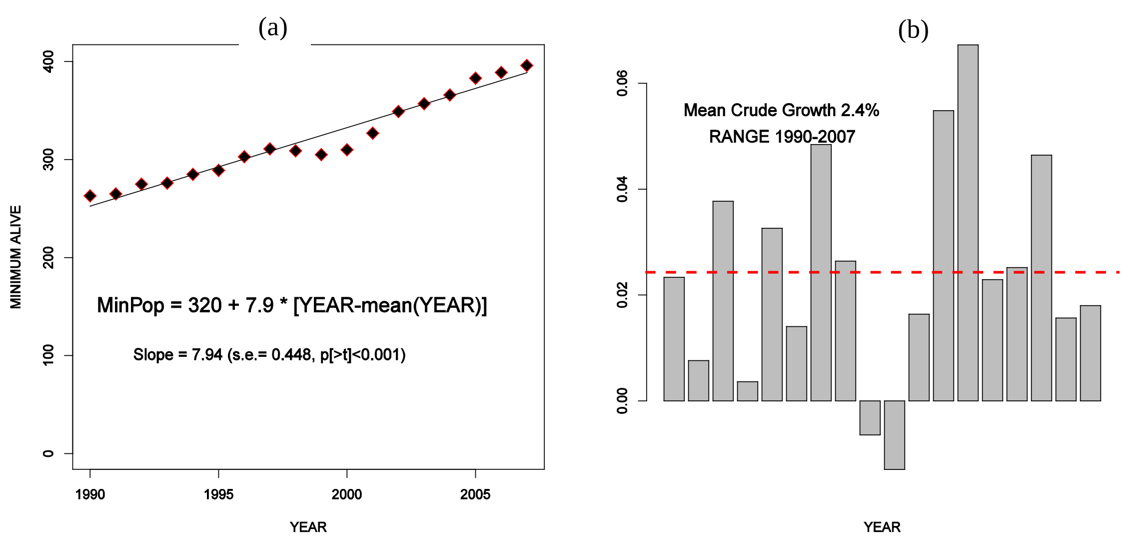
The western North Atlantic population size was estimated to be at least 396~~61~~ individuals in 2007~~5~~ based on a census of individual whales identified using photo-identification techniques. This value is a minimum and does not include animals that were alive prior to 2007~~5~~, but not recorded in the individual sightings database as seen during ~~from~~ 1 December 2004 to 06 July~~24~~ ~~June~~ 2010~~09~~ (note that matching of photos taken during 2008~~6~~-2010~~09~~ was not complete at the time the data were received). It also does not include some calves known to be born during 2007~~5~~, or any other individual whale seen during 2007~~5~~ but not yet entered into the catalog.

Current Population Trend

The population growth rate reported for the period 1986-1992 by Knowlton *et al.* (1994) was 2.5% (CV=0.12), suggesting that the stock was showing signs of slow recovery. However, work by Caswell *et al.* (1999) suggested that crude survival probability declined from about 0.99 in the early 1980s to about 0.94 in the late 1990s. The decline was statistically significant. Additional work conducted in 1999 was reviewed by the IWC workshop on status and trends in this population (Best *et al.* 2001); the workshop concluded based on several analytical approaches that survival had indeed declined in the 1990s. Although capture heterogeneity could negatively bias survival estimates, the workshop concluded that this factor could not account for the entire observed decline, which appeared to be particularly marked in adult females. Another workshop was convened by NMFS in September 2002, and reached similar conclusions regarding the decline in the population (Clapham 2002).

An increase in mortality in 2004 and 2005 was cause for serious concern (Kraus *et al.* 2005). Calculations based on demographic data through 1999 (Fujiwara and Caswell 2001) indicated that this mortality rate increase would reduce population growth by approximately 10% per year (Kraus *et al.* 2005). Of those mortalities, six were adult females, three of which were carrying near-term fetuses. Furthermore, four of these females were just starting to bear calves, losing their complete lifetime reproduction potential.

Despite the preceding, examination of the minimum number alive population index calculated from the individual sightings database, as it existed on 6~~24~~ July~~ne~~ 2006~~09~~, for the years 1990-2007~~5~~ (Figure 1) suggests a positive trend in population size. These data reveal a significant increase in the number of catalogued whales alive during this period, but with significant variation due to apparent losses exceeding gains during 1998-99. Mean growth rate for the period was 2.4~~1~~%.



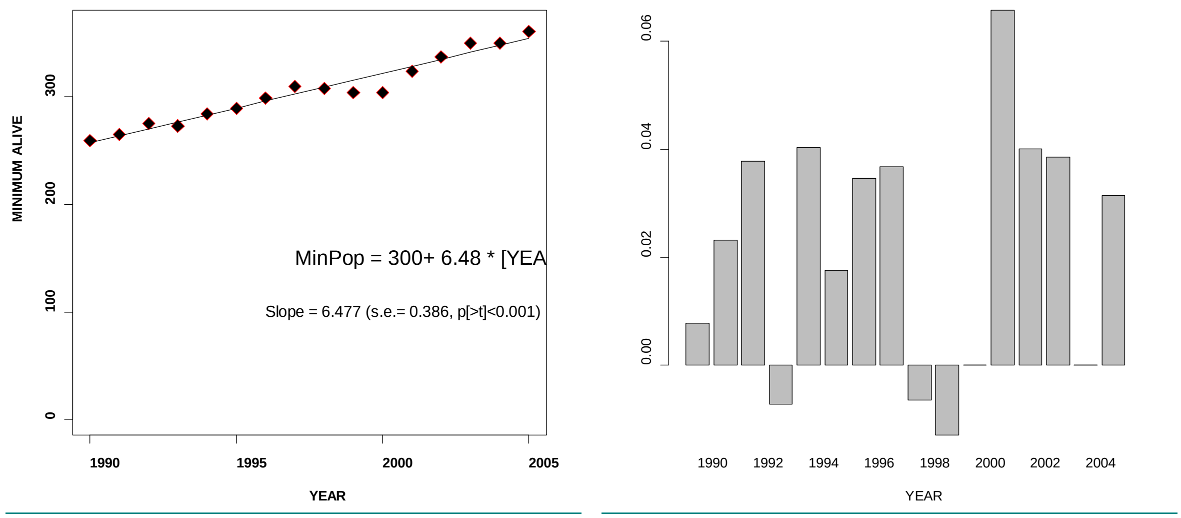


Figure 1. Minimum number alive (a) and crude annual growth rate (b) for cataloged North Atlantic right whales. Minimum number (N) of cataloged individuals known to be alive in any given year includes all whales known to be alive prior to that year and seen in that year or subsequently plus all whales newly catalog~~u~~ed that year. It does not include calves born that year or any other individuals not yet catalog~~u~~ed. Mean crude growth rate (dashed line) is the exponentiated mean of $log_e\ [(N_{t+1}-N_t)/N_t\ ]$ *for each year (t).*

The minimum number alive may increase slightly in later years as analysis of the backlog of unmatched but high-quality photographs proceeds. For example, the minimum number alive for 2002 was calculated to be 313 from a 15 June 2006 data set and revised to 325 using the 30 May 2007 data set.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

During 1980-1992, 145 calves were born to 65 identified cows. The number of calves born annually ranged from 5 to 17, with a mean of 11.2 (SE=0.90). The reproductively active female pool was static at approximately 51 individuals during 1987-1992. Mean calving interval, based on 86 records, was 3.67 years. There was an indication that calving intervals may have been increasing over time, although the trend was not statistically significant (P=0.083) (Knowlton *et al.* 1994).

Total reported calf production and calf mortalities from 1993 to 2009 are shown below in Table 1. The mean calf production for this seventeen year period was 17.2 (15.3-19.4; 95% C.I.). During the 2004 and 2005 calving seasons three adult females were found dead with near-term fetuses.

An updated analysis of calving intervals through the 1997/1998 season suggests that the mean calving interval increased since 1992 from 3.67 years to more than 5 years, a significant trend (Kraus *et al.* 2001). This conclusion was supported by modeling work reviewed by the IWC workshop on status and trends in this population (Best *et al.* 2001); the workshop agreed that calving intervals had indeed increased and further that the reproductive rate was approximately half that reported from studied populations of southern right whales, *E. australis*. A workshop on possible causes of reproductive failure was held in April 2000 (Reeves *et al.* 2001). Factors considered included contaminants, biotoxins, nutrition/food limitation, disease, and inbreeding problems. While no conclusions were reached, a research plan to further investigate this topic was developed. Analyses completed since that workshop found that in the most recent years, calving intervals were closer to ~~three~~ 3 years (Kraus *et al.* 2007).

An analysis of the age structure of this population suggests that it contains a smaller proportion of juvenile whales than expected (Hamilton *et al.* 1998; Best *et al.* 2001), which may reflect lowered recruitment and/or high juvenile mortality. In addition, it is possible that the apparently low reproductive rate is due in part to an unstable age structure or to reproductive senescence on the part of some females. However, few data are available on either factor and senescence has not been documented for any baleen whale.

Table 1. North Atlantic right whale calf production and mortality, 1993-2009.

Year[a]	Reported calf production	Reported calf mortalities

1993	8	2
1994	9	0
1995	7	0
1996	22	3
1997	20	1
1998	6	1
1999	4	0
2000	1	0
2001	31	4
2002	21	2
2003	19	0
2004	17	1
2005	28	0
2006	19	2
2007	23	2
2008	23	2
2009	39	1
a. includes December of the previous year		

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is the product of minimum population size, one-half the maximum net productivity rate and a "recovery" factor for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The recovery factor for right whales is 0.10 because this species is listed as endangered under the Endangered Species Act (ESA). The minimum population size is 396~~61~~ and the observed net productivity is 0.024. Half of the observed net productivity is 0.012, thus PBR for the Western Atlantic stock of North Atlantic Right whale is 0.~~8~~5~~7~~.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period ~~2004~~ 2005 through ~~2008~~2009, the minimum rate of annual human-caused mortality and serious injury to right whales averaged 2.~~8~~ 6 per year (U.S. waters, ~~2.2~~1.6; Canadian waters, ~~0.6~~1.0). This is derived from two components: 1) incidental fishery entanglement records at ~~0.8~~1.0 per year (U.S. waters, 0.~~6~~4; Canadian waters, 0.~~2~~6), and 2) ship strike records at ~~2.0~~1.6 per year (U.S. waters, 1.~~6~~2; Canadian waters, 0.4). Beginning with the 2001 Stock Assessment Report, Canadian records were incorporated into the mortality and serious injury rates of this report to reflect the effective range of this stock. It is also important to stress that serious injury determinations are made based upon the best available information; these determinations may change with the availability of new information (Cole *et al.* 2005). For the purposes of this report, discussion is primarily limited to those records considered confirmed human-caused mortalities or serious injuries. For more information on determinations for this period, see ~~Glass~~ Henry *et al.* (~~2010~~2011).

Background

The details of a particular mortality or serious injury record often require a degree of interpretation. The assigned cause is based on the best judgment of the available data; additional information may result in revisions. When reviewing Table 2 below, several factors should be considered: 1) a ship strike or entanglement may occur at some distance from the reported location; 2) the mortality or injury may involve multiple factors; for example, whales that have been both ship struck and entangled are not uncommon; 3) the actual vessel or gear type/source is often uncertain; and 4) in entanglements, several types of gear may be involved.

The serious injury determinations are susceptible to revision. There are several records where a struck and injured whale was re-sighted later, apparently healthy, or where an entangled or partially disentangled whale was re-sighted later free of gear. The reverse may also be true: a whale initially appearing in good condition after being struck or entangled is later re-sighted and found to have been seriously injured by the event. Entanglements of juvenile whales are typically considered serious injuries because the constriction on the animal is likely to become increasingly lethal as the whale grows (Cole *et al.* 2005; Nelson *et al.* 2007).

A serious injury was defined in 50 CFR part 229.2 as an injury that is likely to lead to mortality. We therefore limited the serious injury designation to only those reports that had substantiated evidence that the injury, whether from entanglement or vessel collision, was likely to lead to the whale's death (Cole *et al.* 2005; Nelson *et al.* 2007;

Glass *et al.* 2008; Glass *et al.* 2010; Henry *et al.* 2011). Determinations of serious injury were made on a case-by-case basis following recommendations from the workshop conducted in 1997 on differentiating serious and non-serious injuries (Angliss and DeMaster 1998). Injuries that impeded a whale's locomotion or feeding were not considered serious injuries unless they were likely to be fatal in the foreseeable future. There was no forecasting of how the entanglement or injury may increase the whale's susceptibility to further injury, namely from additional entanglements or vessel collisions. This conservative approach likely underestimates serious injury rates.

With these caveats, the total minimum detected annual average human-induced mortality and serious injury incurred by this stock (including fishery and non-fishery related causes) is 2.~~8~~ 6 right whales per year (U.S. waters ~~2.2~~1.6; Canadian waters, ~~0.6~~1.0). As with entanglements, some injury or mortality due to ship strikes is almost certainly undetected, particularly in offshore waters. Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or necropsied) represent lost data, some of which may relate to human impacts. For these reasons, the estimate of 2.~~8~~ 6 right whales per year must be regarded as derived from minimum count (~~Glass~~ Henry *et al.* ~~2010~~2011).

Further, the small population size and low annual reproductive rate of right whales suggest that human sources of mortality may have a greater effect relative to population growth rates than for other whales. The principal factors believed to be retarding growth and recovery of the population are ship strikes and entanglement with fishing gear. Between 1970 and 1999, a total of 45 right whale mortalities was recorded (IWC [International Whaling Commission] 1999; Knowlton and Kraus 2001; Glass *et al.* 2009). Of these, 13 (28.9%) were neonates that were believed to have died from perinatal complications or other natural causes. Of the remainder, 16 (35.6%) resulted from ship strikes, 3 (6.7%) were related to entanglement in fishing gear (in two cases lobster gear, and one gillnet gear), and 13 (28.9%) were of unknown cause. At a minimum, therefore, 42.2% of the observed total for the period and 50% of the 32 non-calf deaths were attributable to human impacts (calves accounted for three deaths from ship strikes). Young animals, ages 0-4 years, are apparently the most impacted portion of the population (Kraus 1990).

Finally, entanglement or minor vessel collisions may not kill an animal directly, but may weaken or otherwise affect it so that it is more likely to become vulnerable to further injury. Such was apparently the case with the two-year-old right whale killed by a ship off Amelia Island, Florida in March 1991 after having carried gillnet gear wrapped around its tail region since the previous summer (Kenney and Kraus 1993). A similar fate befell right whale #2220, found dead on Cape Cod in 1996.

Fishery-Related Serious Injury and Mortality

Reports of mortality and serious injury relative to PBR as well as total human impacts are contained in records maintained by the New England Aquarium and the NMFS Northeast and Southeast Regional Offices (Table 2). From ~~2004~~ 2005 through ~~2008~~2009, ~~4~~ 5 of ~~14~~ 13 records of mortality or serious injury (including records from both USA and Canadian waters) involved entanglement or fishery interactions. For this time frame, the average reported mortality and serious injury to right whales due to fishery entanglement was ~~0.8~~1.0 whales per year (U.S. waters, 0.~~6~~4; Canadian waters, 0.~~2~~6). Information from an entanglement event often does not include the detail necessary to assign the entanglements to a particular fishery or location.

Although disentanglement is either unsuccessful or not possible for the majority of cases, during the period ~~2004~~ 2005 through ~~2008~~2009, there were at least ~~four~~ three documented cases of entanglements for which the intervention of disentanglement teams averted a likely serious-injury determination. ~~On 6 December 2004, a one-year-old female, #3314, was sighted with line wrapped on both its head and tail which would likely have been fatal. Following more than three weeks of attempts, the constricting fishing gear was removed.~~ On 3 December 2005, #3445—the 2004 calf of #2145—was first sighted off Brunswick, Georgia, with line across its back and around its right flipper. Over 300 feet of trailing line was removed. This whale was resighted on 12 June 2006, apparently gear-free. An adult female, #2029, first sighted entangled in the Great South Channel on 9 March 2007, may have avoided serious injury due to being partially disentangled on 18 September 2007 by researchers in the Bay of Fundy, Canada. On 8 December 2008, ~~Eg number~~ #3294 was successfully disentangled. Sometimes, even with disentanglement, an animal may die of injuries sustained from fishing gear. A female yearling right whale, #3107 was first sighted with gear wrapping its caudal peduncle on 6 July 2002 near Briar Island, Nova Scotia. Although the gear was removed on 1 September by the New England Aquarium disentanglement team, and the animal seen alive on an aerial survey on 1 October, its carcass washed ashore at Nantucket on 12 October, 2002 with deep entanglement injuries on the caudal peduncle.

In January 1997, NMFS changed the classification of the Gulf of Maine and U.S. mid-Atlantic lobster pot fisheries from Category III to Category I based on examination of stranding and entanglement records of large whales from 1990 to 1994 (62 FR 33, Jan. 2, 1997).

The only bycatch of a right whale observed by the Northeast Fisheries Observer Program was in the pelagic drift gillnet fishery in 1993. No mortalities or serious injuries have been documented in any of the other fisheries monitored by NMFS.

Entanglement records from 1990 through ~~2008~~ 2009 maintained by NMFS Northeast Regional Office (NMFS, unpublished data) included ~~47~~ 85 confirmed right whale entanglements, including right whales in weirs, gillnets, and trailing line and buoys. Because whales often free themselves of gear following an entanglement event, scarring may be a better indicator of fisheries interaction than entanglement records. In an analysis of the scarification of right whales, 338 of 447 (75.6%) whales examined during 1980-2002 were scarred at least once by fishing gear (Knowlton *et al.* 2005). Further research using the North Atlantic Right Whale Catalogue has indicated that, annually, between 14% and 51% of right whales are involved in entanglements (Knowlton *et al.* 2005). Incidents of entanglements in groundfish gillnet gear, cod traps, and herring weirs in waters of Atlantic Canada and the U.S. east coast were summarized by Read (1994). In six records of right whales that were entangled in groundfish gillnet gear in the Bay of Fundy and Gulf of Maine between 1975 and 1990, the whales were either released or escaped on their own, although several whales were observed carrying net or line fragments. A right whale mother and calf were released alive from a herring weir in the Bay of Fundy in 1976.

For all areas, specific details of right whale entanglement in fishing gear are often lacking. When direct or indirect mortality occurs, some carcasses come ashore and are subsequently examined, or are reported as "floaters" at sea. The number of unreported and unexamined carcasses is unknown, but may be significant in the case of floaters. More information is needed about fisheries interactions and where they occur.

Other Mortality

Ship strikes are a major cause of mortality and injury to right whales (Kraus 1990; Knowlton and Kraus 2001). Records from ~~2004~~ 2005 through ~~2008~~ 2009 have been summarized in Table 2. For this time frame, the average reported mortality and serious injury to right whales due to ship strikes was ~~2.0~~1.6 whales per year (U.S. waters, 1.~~6~~2; Canadian waters, 0.4).

~~Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic right whales, January 2004 through December 2008.~~

~~Date[a]~~	~~Report Type[b]~~	~~Age, Sex, ID, Length~~	~~Location[a]~~	~~Assigned Cause: P=primary, S=secondary~~		~~Notes/Observations~~
				~~Ship strike~~	~~Entang./ Fsh inter~~	
~~02/07/04~~	~~mortality~~	~~Adult Female #1004 16.0m~~	~~Virginia Beach, VA~~	~~P~~		~~Severe subdermal bruising; complete fracture of rostrum and laceration of oral rete~~
~~09/06/04~~	~~mortality~~	~~Adult Female #2301 15m (est)~~	~~Roseway Basin, NS~~		~~P~~	~~Extensive constricting line on head and left flipper; found dead March 3, 2005 on Ship Shoal Island, VA; gear recovered consists of 10 fathoms of 3/8" & 7/16" rope~~
~~11/24/04~~	~~mortality~~	~~Adult Female #1909 14.9m~~	~~Ocean Sands, NC~~	~~P~~		~~Left fluke lobe severed and large bore blood vessels exposed~~
~~01/12/05~~	~~mortality~~	~~Adult Female #2143 13.1m~~	~~Cumberland Island, GA~~	~~P~~		~~Healed propeller wounds from strike as a calf re-opened as a result of pregnancy~~

03/10/05	serious injury	Adult[c] Female[c] #2425	Cumberland Island, GA	P		43 ft power yacht partially severed left fluke; last resighted 9/4/05 in extremely poor condition
04/28/05	mortality	Adult Female #2617 14.7m	Monomoy Island, MA	P		Significant bruising and multiple vertebral fractures
01/10/06	mortality	Calf Male 5.4m w/out fluke	Jacksonville, FL	P		Propeller lacerations associated with hemorrhaging and edema; flukes completely severed
01/22/06	mortality	Calf Female[c] 5.6m	off Ponte Vedra Beach, FL		P	Significant pre-mortem lesions from entanglement in apparent monofilament netting; no gear present
03/11/06	serious injury	Yearling Male #3522	Off Cumberland Island, GA	P		11 propeller lacerations across dorsal surface; not resighted since
07/24/06	mortality	age unknown Female 9.6m	Campobello Island, NB	P		Propeller lacerations through blubber, into muscle and ribs
08/24/06	mortality	Adult Female 14.7m	Roseway Basin, NS	P		16 fractured vertebrae; dorsal blubber bruise from head to genital region
12/30/06	mortality	Yearling Male #3508 12.6m	off Brunswick, GA	P		20 propeller lacerations along right side of head and back with associated hemorrhaging
03/31/07	mortality	Calf Male 7.7 m	Outer Banks, NC		P	Edema associated with flipper and dorsal & ventral thoracic musculature; epidermal abrasion indicated entangling body and flipper wraps; no gear recovered
02/03/08	serious injury	Adult Male #1980	Cape Hatteras, NC		P	Embedded wrap in rostrum; decline in health; no gear recovered; last resighted 04/16/2008

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson et al. 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.
c. Additional information that was not included in previous reports.

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic right whales, January 2005 through December 2009.

Date[a]	Report Type[b]	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary	Notes/Observations

				Ship strike	Entang./ Fsh inter	
1/12/2005	mortality	Adult Female #2143 13.1m	Cumberland Island, GA	P	-	Healed propeller wounds from strike as a calf reopened as a result of pregnancy
3/10/2005	serious injury	Adult[b] Female[b] #2425	Cumberland Island, GA	P	-	43 ft power yacht partially severed left fluke; resighted 9/4/05 in extremely poor condition, not seen since
4/28/2005	mortality	Adult Female #2617 14.7m	Monomoy Island, MA	P	-	Significant bruising and multiple vertebral fractures
1/10/2006	mortality	Calf Male 5.4m w/out fluke	Jacksonville, FL	P	-	Propeller lacerations associated with hemorrhaging and edema; flukes completely severed
1/22/2006	mortality	Calf Female[b] 5.6m	off Ponte Vedra Beach, FL	-	P	Significant premortem lesions from entanglement in apparent monofilament netting; no gear present
3/11/2006	serious injury	Yearling Male #3522	Off Cumberland Island, GA	P	-	11 propeller lacerations across dorsal surface; not sighted since
7/24/2006	mortality	age unknown Female 9.6m	Campobello Island, NB	P	-	Propeller lacerations through blubber, into muscle and ribs
8/24/2006	mortality	Adult Female 14.7m	Roseway Basin, NS	P	-	16 fractured vertebrae; dorsal blubber bruise from head to genital region
12/30/2006	mortality	Yearling Male #3508 12.6m	off Brunswick, GA	P	-	20 propeller lacerations along right side of head and back with associated hemorrhaging
3/31/2007	mortality	Calf Male 7.7m	Outer Banks, NC	-	P	Edema associated with flipper and dorsal & ventral thoracic musculature; epidermal abrasion indicated entangling body and flipper wraps; no gear recovered
2/3/2008	serious injury	Adult Male #1980	Cape Hatteras, NC	-	P	Embedded wrap in rostrum; decline in health; no gear recovered
1/14/2009	serious injury	Juvenile sex unknown #3311	off Brunswick, GA	-	P	Partial disentanglement 03/06/2008; not seen since; embedded wrap in rostrum & lip removed; decline in health; gear analysis pending
1/27/2009	serious injury	Juvenile Male #3710 9.8m	Cape Lookout Shoals, NC	-	P	Live stranded w/ spinal scoliosis; euthanized; necropsy determined scoliosis due to entanglement and not congenital; entanglement wounds

						chronically infected; no gear recovered

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.

b. Additional information which was not included in previous reports.

STATUS OF STOCK

The size of this stock is considered to be extremely low relative to OSP in the U.S. Atlantic EEZ, and this species is listed as endangered under the ESA. The North Atlantic right whale is considered one of the most critically endangered populations of large whales in the world (Clapham *et al.* 1999). A Recovery Plan has been published for the North Atlantic right whale and is in effect (NMFS [National Marine Fisheries Service] 2005). NMFS is presently engaged in evaluating the need for critical habitat designation for the North Atlantic right whale. Under a prior listing as northern right whale, three critical habitats, Cape Cod Bay/Massachusetts Bay, Great South Channel, and the Southeastern U.S., were designated by NMFS (59 FR 28793, June 3, 1994). Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the North Atlantic right whale (Brown *et al.* 2009). A National Marine Fisheries Service ESA status review in 1996 concluded that the western North Atlantic population remains endangered. This conclusion was reinforced by the International Whaling Commission (Best *et al.* 2001), which expressed grave concern regarding the status of this stock. Relative to populations of southern right whales, there are also concerns about growth rate, percentage of reproductive females, and calving intervals in this population. The total level of human-caused mortality and serious injury is unknown, but reported human-caused mortality and serious injury was a minimum of 3.0 right whales per year from 2004 through 2008. Given that PBR has been set to 0.7, no mortality or serious injury for this stock can be considered insignificant. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and also because the North Atlantic right whale is an endangered species.

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HUMPBACK WHALE (*Megaptera novaeangliae*): Gulf of Maine Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the western North Atlantic, humpback whales feed during spring, summer and fall over a geographic range encompassing the eastern coast of the United States (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (Katona and Beard 1990). Other North Atlantic feeding grounds occur off Iceland and northern Norway, including off Bear Island and Jan Mayen (Christensen *et al.* 1992; Palsbøll *et al.* 1997). These six regions represent relatively discrete subpopulations, fidelity to which is determined matrilineally (Clapham and Mayo 1987). Genetic analysis of mitochondrial DNA (mtDNA) has indicated that this fidelity has persisted over an evolutionary timescale in at least the Icelandic and Norwegian feeding grounds (Palsbøll *et al.* 1995; Larsen *et al.* 1996). Previously, the North Atlantic humpback whale population was treated as a single stock for management purposes (Waring *et al.* 1999). Indeed, earlier genetic analyses (Palsbøll *et al.* 1995), based upon relatively small sample sizes, had failed to discriminate among the four western North Atlantic feeding areas. However, genetic analyses often reflect a timescale of thousands of years, well beyond those commonly used by managers. Accordingly, the decision was made to reclassify the Gulf of Maine as a separate feeding stock (Waring *et al.* 2000); this was based upon the strong fidelity by individual whales to this region, and the attendant assumption that, were this subpopulation wiped out, repopulation by immigration from adjacent areas would not occur on any reasonable management timescale. This reclassification has subsequently been supported by new genetic analyses based upon a much larger collection of samples than those utilized by Palsbøll *et al.* (1995). These analyses have found significant differences in mtDNA haplotype frequencies among whales sampled in four western feeding areas, including the Gulf of Maine (Palsbøll *et al.* 2001). During the 2002 Comprehensive Assessment of North Atlantic humpback whales, the International Whaling Commission acknowledged the evidence for treating the Gulf of Maine as a separate management unit (IWC 2002).

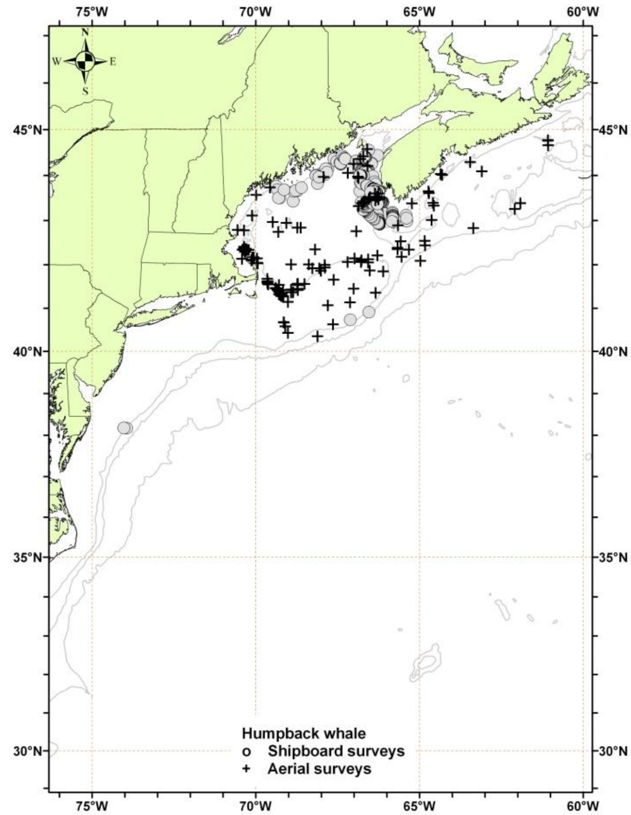

Figure 1. *Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006, and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

During the summers of 1998 and 1999, the Northeast Fisheries Science Center conducted surveys for humpback whales on the Scotian Shelf to establish the occurrence and population identity of the animals found in this region, which lies between the well-studied populations of the Gulf of Maine and Newfoundland. Photographs from both surveys have now been compared to both the overall North Atlantic Humpback Whale Catalogue and a large regional catalogue from the Gulf of Maine (maintained by the College of the Atlantic and the Provincetown Center for Coastal Studies, respectively); this work is summarized in Clapham *et al.* (2003). The match rate between the Scotian Shelf and the Gulf of Maine was 27% (14 of 52 Scotian Shelf individuals from both years). Comparable rates of exchange were obtained from the southern (28%, n=10 of 36 whales) and northern (27%, *n*=4 of 15 whales) ends of the Scotian Shelf, despite the additional distance of nearly 100 nautical miles (one whale was observed in both areas). In contrast, all of the 36 humpback whales identified by the same NMFS surveys elsewhere in the Gulf of Maine (including Georges Bank, southwestern Nova Scotia and the Bay of Fundy) had been previously observed in the Gulf of Maine region. The sighting histories of the 14 Scotian Shelf whales matched to the Gulf of Maine suggested that many of them were transient through the latter area. There were no matches between the Scotian Shelf and any other North Atlantic feeding ground, except the Gulf of Maine; however, instructive comparisons are compromised by the often low sampling effort in other regions in recent years. Overall, it appears that the northern range of many members of the Gulf of Maine stock does not extend onto the Scotian Shelf.

During winter, whales from most North Atlantic feeding areas (including the Gulf of Maine) mate and calve in the West Indies, where spatial and genetic mixing among ~~subpopulations~~ feeding groups occurs (Katona and Beard 1990; Clapham *et al.* 1993; Palsbøll *et al.* 1997; Stevick *et al.* 1998). A few whales likely using~~of~~ ~~unknown~~ eastern North Atlantic ~~northern origin~~ feeding areas migrate to the Cape Verde Islands (Reiner *et al.* 1996; Wenzel et al. 2009) ~~Reiner *et al.* 1996~~). In the West Indies, the majority of whales are found in the waters of the Dominican Republic, notably on Silver Bank and Navidad Bank, and in Samana Bay (Balcomb and Nichols 1982; Whitehead and Moore 1982; Mattila *et al.* 1989; Mattila *et al.* 1994). Humpback whales are also found at much lower densities throughout the remainder of the Antillean arc, from Puerto Rico to the coast of Venezuela (Winn *et al.* 1975; Levenson and Leapley 1978; Price 1985; Mattila and Clapham 1989).

Not all whales migrate to the West Indies every winter, and significant numbers of animals are found in mid- and high-latitude regions at this time (Clapham *et al.* 1993; Swingle *et al.* 1993). An increased number of sightings of humpback whales in the vicinity of the Chesapeake and Delaware Bays occurred in 1992 (Swingle *et al.* 1993). Wiley *et al.* (1995) reported that 38 humpback whale strandings occurred during 1985-1992 in the U.S. mid-Atlantic and southeastern states. Humpback whale strandings increased, particularly along the Virginia and North Carolina coasts, and most stranded animals were sexually immature; in addition, the small size of many of these whales strongly suggested that they had only recently separated from their mothers. Wiley *et al.* (1995) concluded that these areas were becoming an increasingly important habitat for juvenile humpback whales and that anthropogenic factors may negatively impact whales in this area. There have also been a number of wintertime humpback sightings in coastal waters of the southeastern U.S. (NMFS unpublished data; New England Aquarium unpublished data). Whether the increased numbers of sightings represent a distributional change, or are simply due to an increase in sighting effort and/or whale abundance, is unknown.

A key question with regard to humpback whales off the southeastern and mid-Atlantic states is their population identity. This topic was investigated using fluke photographs of living and dead whales observed in the region (Barco *et al.* 2002). In this study, photographs of 40 whales (alive or dead) were of sufficient quality to be compared to catalogs from the Gulf of Maine (i.e., the closest feeding ground) and other areas in the North Atlantic. Of 21 live whales, 9 (43~~2.9~~%) matched to the Gulf of Maine, 4 (19~~.0~~%) to Newfoundland and 1 (4.8%) to the Gulf of St Lawrence. Of 19 dead humpbacks, 6 (31.6%) were known Gulf of Maine whales. Although the population composition of the mid-Atlantic is apparently dominated by Gulf of Maine whales, lack of recent photographic effort in Newfoundland makes it likely that the observed match rates under-represent the true presence of Canadian whales in the region. Barco *et al.* (2002) suggested that the mid-Atlantic region primarily represents a supplemental winter feeding ground used by humpbacks.

In New England waters, feeding is the principal activity of humpback whales, and their distribution in this region has been largely correlated to abundance of prey species, although behavior and bottom topography are factors influencing foraging strategy (Payne *et al.* 1986, 1990). Humpback whales are frequently piscivorous when in New England waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes* spp.), and other small fishes. In the northern Gulf of Maine, euphausiids are also frequently taken (Paquet *et al.* 1997). Commercial depletion of herring and mackerel led to an increase in sand lance in the southwestern Gulf of Maine in the ~~mid~~ mid-1970s with a concurrent decrease in humpback whale abundance in the northern Gulf of Maine. Humpback whales were densest over the sandy shoals in the southwestern Gulf of Maine favored by the sand lance during much of the late 1970s and early 1980s, and humpback distribution appeared to have shifted to this area (Payne *et al.* 1986). An apparent reversal began in the ~~mid~~ mid-1980s, and herring and mackerel increased as sand lance again decreased (Fogarty *et al.* 1991). Humpback whale abundance in the northern Gulf of Maine increased markedly during 1992-1993, along with a major influx of herring (P. Stevick, pers. comm.). Humpback whales were few in nearshore Massachusetts waters in the 1992-1993 summer seasons. They were more abundant in the offshore waters of Cultivator Shoal and on the Northeast Peak on Georges Bank and on Jeffreys Ledge; these latter areas are traditional locations of herring occurrence. In 1996 and 1997, sand lance and therefore humpback whales were once again abundant in the Stellwagen Bank area. However, unlike previous cycles, when an increase in sand lance corresponded to a decrease in herring, herring remained relatively abundant in the northern Gulf of Maine, and humpbacks correspondingly continued to occupy this portion of the habitat, where they also fed on euphausiids (unpublished data, Provincetown

Center for Coastal Studies and College of the Atlantic). Diel patterns in humpback foraging behavior have been shown to correlate with diel patterns in sand lance behavior (Friedlaender *et al.* 2009).

In early 1992, a major research program known as the Years of the North Atlantic Humpback (YONAH) (Smith *et al.* 1999) was initiated. This was a large-scale, intensive study of humpback whales throughout almost their entire North Atlantic range, from the West Indies to the Arctic. During two primary years of field work, photographs for individual identification and biopsy samples for genetic analysis were collected from summer feeding areas and from the breeding grounds in the West Indies. Additional samples were collected from certain areas in other years. Results pertaining to the estimation of abundance and to genetic population structure are summarized below.

POPULATION SIZE

North Atlantic Population

The overall North Atlantic population (including the Gulf of Maine), derived from genetic tagging data collected by the YONAH project on the breeding grounds, was estimated to be 4,894 males (95% CI=3,374-7,123) and 2,804 females (95% CI=1,776-4,463) (Palsbøll *et al.* 1997). Because the sex ratio in this population is known to be even (Palsbøll *et al.* 1997), the excess of males is presumed a result of sampling bias, lower rates of migration among females, or sex-specific habitat partitioning in the West Indies; whatever the reason, the combined total is an underestimate of overall population size. Photographic mark-recapture analyses from the YONAH project provided an ocean-basin-wide estimate of 11,570 animals during 1992/1993 (CV=0.068, Stevick *et al.* 2003), and an additional genotype-based analysis yielded a similar but less precise estimate of 10,400 whales (CV=0.138, 95% CI=8,000 to 13,600) (Smith *et al.* 1999). In the northeastern North Atlantic, Øien (2001) estimated from sighting survey data that there were 889 (CV=0.32) humpback whales in the Barents and Norwegian Seas region.

Gulf of Maine stock - earlier estimates

Please see Appendix IV for earlier estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), if estimates are older than eight years ~~are deemed unreliable and should not be used for~~ PBR is ~~determinations~~undetermined.

Gulf of Maine Stock - Recent surveys and abundance estimates

~~An abundance estimate of 521 (CV=0.67) humpback whales was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)* used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.~~

An abundance estimate of 359 (CV=0.75) humpback whales was obtained from a line-transect sighting survey conducted from 12 June to 4 August 2004 by a ship and plane. The 2004 survey covered the smallest portion of the habitat (6,180 km of trackline), from the ~~100~~ 100-m depth contour on the southern Georges Bank to the lower Bay of Fundy; while the Scotian ~~shelf~~ Shelf south of Nova Scotia was not surveyed.

An abundance estimate of 847 animals (CV=0.55) was derived from a line-transect sighting survey conducted during August 2006 which covered 10,676 km of trackline from the ~~2000~~ 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the Gulf of St. Lawrence. (Table 1; Palka pers. comm.) Some evidence exists to support a 25% exchange rate between Scotian shelf animals and with those in the Gulf of Maine (Clapham *et al.* 2003), which suggest that a 25% correction factor be applied to the humpback population estimate from the Scotian ~~shelf~~ Shelf stratum. Because the Scotian ~~shelf~~ Shelf was surveyed in only 2006, the 25% correction factor (described above) was applied to only the 2006 abundance estimate.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for Gulf of Maine humpback whales is 847 animals (CV=0.55). The minimum population estimate for this stock is 549 animals.

Table 1. Summary of abundance estimates for Gulf of Maine humpback whales with month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).			
Month/Year	**Type**	**N_{best}**	**CV**
~~Aug 2002~~	~~S. Gulf of Maine to Maine~~	~~521~~	~~0.67~~
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	359	0.75
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	847	0.55

Current Population Trend

As detailed below, current data suggest that the Gulf of Maine humpback whale stock is steadily increasing in size. This is consistent with an estimated average trend of 3.1% (SE=0.005) in the North Atlantic population overall for the period 1979-1993 (Stevick *et al.* 2003), although there are no feeding-area-specific estimates.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Barlow and Clapham (1997), applying an interbirth interval model to photographic mark-recapture data, estimated the population growth rate of the Gulf of Maine humpback whale stock at 6.5% (CV=0.012). Maximum net productivity is unknown for this population, although a theoretical maximum for any humpback population can be calculated using known values for biological parameters (Brandão *et al.* 2000; Clapham *et al.* 2001). For the Gulf of Maine stock, data supplied by Barlow and Clapham (1997) and Clapham *et al.* (1995) give values of 0.96 for survival rate, 6 years as mean age at first parturition, 0.5 as the proportion of females, and 0.42 for annual pregnancy rate. From this, a maximum population growth rate of 0.072 is obtained according to the method described by Brandão *et al.* (2000). This suggests that the observed rate of 6.5% (Barlow and Clapham 1997) is close to the maximum for this stock.

Clapham *et al.* (2003) updated the Barlow and Clapham (1997) analysis using data from the period 1992 to 2000. The population growth estimate was either 0% (for a calf survival rate of 0.51) or 4.0% (for a calf survival rate of 0.875). Although confidence limits were not provided (because maturation parameters could not be estimated), both estimates of population growth rate are outside the 95% confidence intervals of the previous estimate of 6.5% for the period 1979 to 1991 (Barlow and Clapham 1997). It is unclear whether this apparent decline is an artifact resulting from a shift in distribution; indeed, such a shift occurred during exactly the period (1992-1995) in which survival rates declined. It is possible that this shift resulted in calves that were born in those years imprinting on (and thus subsequently returning to) areas other than those in which intensive sampling occurred. If the decline is real, it may be related to known high mortality among young-of-the-year whales in the waters off the U.S. mid-Atlantic states. However, calf survival appears to have increased since 1996, presumably accompanied by an increase in population growth.

In light of the uncertainty accompanying the more recent estimates of population growth rate for the Gulf of Maine stock, the maximum net productivity rate was assumed to be the default value of 0.04 for cetaceans (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the Gulf of Maine stock is 549 whales. The maximum productivity rate is the default value of 0.04. The "recovery" factor, which accounts for endangered, depleted, or threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because this stock is listed as an endangered species under the Endangered Species Act (ESA). PBR for the Gulf of Maine humpback whale stock is 1.1 whales.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period ~~2004~~ 2005 through ~~2008~~2009, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged ~~4.6~~5.0 animals per year (U.S. waters, ~~4.4~~5.0; Canadian waters, 0~~.2~~). This value includes incidental fishery interaction records, 3.~~0~~ 6 (U.S. waters, ~~2.8~~3.6; Canadian waters, 0~~.2~~); and records of vessel collisions, 1.4~~6~~ (U.S. waters, 1.4~~6~~; Canadian waters, 0) (~~Glass~~ Henry *et al.* ~~2010~~2011).

In contrast to stock assessment reports before 2007, these averages include humpback mortalities and serious injuries that occurred in the southeastern and mid-Atlantic states that could not be confirmed as involving members of the Gulf of Maine stock. In past reports, only events involving whales confirmed to be members of the Gulf of Maine stock were counted against the PBR. Starting in the 2007 report, we assumed whales were from the Gulf of Maine unless they were identified as members of another stock. At the time of this writing, no whale was identified as a member of another stock. These determinations may change with the availability of new information. Canadian records were incorporated into the mortality and serious injury rates, to reflect the effective range of this stock as described above. For the purposes of this report, discussion is primarily limited to those records considered confirmed human-caused mortalities or serious injuries.

Serious injury was defined in 50 CFR part 229.2 as an injury that is likely to lead to mortality. We therefore limited serious injury designations to only those reports that had substantiated evidence that the injury, whether from entanglement or vessel collision, was likely to lead to the whale's death. Determinations of serious injury were made on a case-by-case basis following recommendations from the workshop conducted in 1997 on differentiating serious and non-serious injuries (Angliss and DeMaster 1998). Injuries that impeded a whale's locomotion or feeding were not considered serious injuries unless they were likely to be fatal in the foreseeable future. There was no forecasting of how the entanglement or injury might increase the whale's susceptibility to further injury, namely from additional entanglements or vessel collisions. For these reasons, the human impacts listed in this report represent a minimum estimate.

~~To better assess human impacts (both vessel collision and gear entanglement), and considering the number of decomposed and incompletely or unexamined animals in the records, there needs to be greater emphasis on the timely recovery of carcasses and complete necropsies. The literature and review of records described here suggest that there are significant human impacts beyond those recorded in the fishery observer data. For example, a study of entanglement-related scarring on the caudal peduncle of 134 individual humpback whales in the Gulf of Maine suggested that between 48% and 65% had experienced entanglements (Robbins and Mattila 2001). Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or no necropsy performed) represent 'lost data' some of which may relate to human impacts.~~

Background

As with right whales, human impacts (vessel collisions and entanglements) may be slowing recovery of the humpback whale population. Of 20 dead humpback whales (principally in the mid-Atlantic, where decomposition did not preclude examination for human impacts), Wiley *et al.* (1995) reported that six (30%) had major injuries possibly attributable to ship strikes, and five (25%) had injuries consistent with ~~possible~~ entanglement in fishing gear. One whale displayed scars that may have been caused by both ship strike and entanglement. Thus, 60% of the whale carcasses suitable for examination showed signs that anthropogenic factors may have contributed to, or been responsible for, their death. Wiley *et al.* (1995) further reported that all stranded animals were sexually immature, suggesting a winter or migratory segregation and/or that juvenile animals are more susceptible to human impacts.

An updated analysis of humpback whale mortalities from the mid-Atlantic states region was produced by Barco *et al.* (2002). Between 1990 and 2000, there were 52 known humpback whale mortalities in the waters of the U.S. mid-Atlantic states. Inspection of length data from 48 of these whales (18 females, 22 males, and 8 of unknown sex) suggested that 39 (81.2%) were first-year animals, 7 (14.6%) were immature and 2 (4.2%) were adults. However, sighting histories of five of the dead whales indicate that some were small for their age, and histories of live whales further indicate that the proportion of mature whales in the mid-Atlantic may be higher than suggested by the stranded sample.

Robbins and Mattila (2001) reported that males were more likely to be entangled than females. Their scarring data suggested that yearlings were more likely than other age classes to be involved in entanglements. ~~Finally, female humpbacks showing evidence of prior entanglements produced significantly fewer calves, suggesting that entanglement may significantly impact reproductive success.~~

Humpback whale entanglements also occur in relatively high numbers in Canadian waters. Reports of interactions with fixed fishing gear set for groundfish around Newfoundland averaged 365 annually from 1979 to 1987 (range 174-813). An average of 50 humpback whale entanglements (range 26-66) was reported annually between 1979 and 1988, and 12 of 66 humpback whales entangled in 1988 died (Lien *et al.* 1988). Two humpbacks were reported entangled in fishing gear in Newfoundland and Labrador waters in 2005. One towed away the gear and was not re-sighted, and the other was released alive (Ledwell and Huntington 2006). Eighty-four humpbacks were reported entangled in fishing gear in Newfoundland and Labrador from 2000 to 2006 (W. Ledwell, pers. comm.). Volgenau *et al.* (1995) reported that in Newfoundland and Labrador, cod traps caused the most entanglements and entanglement mortalities (21%) of humpbacks between 1979 and 1992. They also reported that gillnets were the primary cause of entanglements and entanglement mortalities (20%) of humpbacks in the Gulf of Maine between 1975 and 1990. One humpback whale was reported released alive (status unknown) from a herring weir off Grand Manan in 2009 (H. Koopman, UNC Wilmington, pers. comm.).

Disturbance by whale watching may be an important issue in some areas of the population's range, notably the coastal waters of New England where the density of whale watching traffic is seasonally high. However, no studies have been conducted to address this question.

As reported by Wiley *et al.* (1995), serious injuries possibly attributable to ship strikes are more common and probably more serious than those from entanglements. In the NMFS records for 2004 2005 through 20082009, there are 8 7 reports of mortalities as a result of collision with a vessel. No whale involved in the recorded vessel collisions had been identified as a member of a stock other than the Gulf of Maine stock at the time of this writing (Glass Henry *et al.* 20102011).

Fishery-Related Serious Injuries and Mortalities

A description of Fisheries fisheries is provided in Appendix III. Two mortalities were observed in the pelagic drift gillnet fishery, one in 1993 and the other in 1995. In winter 1993, a juvenile humpback was observed entangled and dead in a pelagic drift gillnet along the 200-m isobath northeast of Cape Hatteras. In early summer 1995, a humpback was entangled and dead in a pelagic drift gillnet on southwestern Georges Bank. Additional reports of mortality and serious injury, as well as description of total human impacts, are contained in records maintained by NMFS. A number of these records (11 entanglements involving lobster pot/trap gear) from the 1990-1994 period were the basis used to reclassify the lobster fishery (62 FR 33, Jan. 2, 1997). Large whale entanglements are rarely observed during fisheries sampling operations. However, during 2008, 3 humpback whales were observed as incidental bycatch in 2008: 2 in gillnet gear (1 no serious injury; 1 undetermined) and 1 in a purse seine (released alive).

For this report, the records of dead, injured, and/or entangled humpbacks (found either stranded or at sea) for the period 2004 2005 through 2008 2009 were reviewed. Entanglements accounted for five mortalities and 10 12 serious injuries and was a secondary cause of mortality on another animal. With no evidence to the contrary, all events were assumed to involve members of the Gulf of Maine stock. While these records are not statistically quantifiable in the same way as observer fishery records, they provide some indication of the minimum frequency of entanglements.

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic humpback whales, January 2004 - December 2008. All records were assumed to involve members of the Gulf of Maine humpback whale stock unless a whale was confirmed to be a member of another stock. This is in contrast to prior reports.

Date[a]	Report Type[b]	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
07/11/04	serious injury	Juvenile sex unknown "Lucky"	Briar Island, NS		P	Entanglement on a young whale; no gear recovered
10/03/04	mortality	age unknown Male 15m (est)	Georges Bank		P	Fresh carcass with entangling line and high flyer; no gear recovered

12/19/04	mortality	Calf Female 8.0m	Bethany Beach, DE	P		Hematoma and skeletal fracturing
01/09/06	mortality	Adult Female #8667 14.0m	off Charleston, SC	P		Extensive muscle hemorrhaging; rib fractures; dislocated flipper on left side of animal
03/17/06	mortality	Juvenile Female 10.0m	Virginia Beach, VA	P		Crushed cranium and fractured mandible; hemorrhaging associated with fractures; ventral lacerations consistent with propeller wounds
03/25/06	serious injury	Juvenile sex unknown 8m (est)	Flagler Beach, FL		P	Heavy cyamid load; emaciated; spinal deformity that may or may not have been caused by the entanglement; gear recovered included line and buoys and was identified as lobster pot gear
08/06/06	serious injury	age & sex unknown	Georges Bank		P	Multiple constricting wraps around head; line cutting into upper lip; wraps around both flippers; no gear recovered
08/23/06	serious injury	age & sex unknown 12m (est)	Great South Channel		P	Flukes necrotic and nearly severed as a result of entanglement; pale skin and emaciated; gear recovered included heavy line and wire trap
09/06/06[e]	mortality	age & sex unknown	East of Cape Cod, MA		P	Whale entangled through mouth, continuing back to multiple wraps around peduncle; no gear recovered
10/15/06	mortality	Juvenile Female 10.1m	off Fenwick Island, DE	P	S	Large laceration, penetrating through the bone, across rostrum with accompanying fractures; no gear, but marks around right flipper consistent with entanglement; subdermal hemorrhaging and bone trauma at entanglement point
01/27/07	serious injury	age & sex unknown	off Beach Haven, NJ		P	Body wrap likely to become constricting; random cyamid patches; thin body condition; probable flipper wraps; no gear recovered
05/10/07	mortality	Adult Female 12.5m	off Wachapreague, VA	P		Cranium shattered, hemorrhaging on left lateral side midway between flippers & fluke
05/13/07	mortality	Juvenile Male 9.3m	Rockport, MA	P		Areas of hemorrhaging indicate major blunt trauma to chest, neck & head

06/23/07	serious injury	age unknown “Egg Toss” Male	Wildcat Knoll		P	Body wrap of gear imbedded; no gear recovered
06/24/07	mortality	Juvenile Female “Tofu” 9.9m	Stellwagen Bank	P		Subdermal hemorrhaging involving blubber, fascia, & muscle extending from/around the insertion of the right flipper ventrally to the axilla
12/21/07	mortality	age unknown Male 9.4m	Ocean Sands, NC		P	Documented wrapped in gear, gear removed without permission prior to necropsy; external lesions at flukes, flippers, mouth, dorsal fin, dorsal keel & ventral pleats consistent with gillnet entanglement; emaciated; no gear recovered
01/06/08	serious injury	age & sex unknown 10m (est)	off Cape Lookout, NC		P	Constricting line cutting into right flipper in several places; heavy cyamid load; emaciated; no gear recovered
05/30/08	mortality	age & sex unknown	Georges Bank		P	Constricting body wraps, one wrap under lower jaw; open wound on right flipper; no gear recovered
06/09/08	mortality	age & sex unknown	Georges Bank		P	Constricting body wrap; gear analysis pending
07/08/08	serious injury	Adult Female “Estuary”	off Nauset, MA		P	Cuts were made, but no gear was removed; emaciated; moderate cyamid coverage; deep wounds in fluke blades from gear; hunched over position maintained after cuts were made to the gear; gear analysis pending
08/13/08	serious injury	age & sex unknown 10m (est)	off NJ		P	Partial disentanglement; emaciated; lethargic; heavy cyamid load; gear analysis pending
08/21/08	serious injury	age & sex unknown	off Chatham, MA		P	Evidence of decline in health; no gear recovered
11/04/08	mortality	Juvenile Male 10.1m	Assateague, MD	P		Cranial fractures with associated hemorrhaging

~~a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.~~
~~b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson et al. 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.~~
~~c. Record was added after review of carcasses sighted on 08/20/06 and 09/06/06. Previous reports stated these were the same animal. Recent review could not confirm the resight, therefore they are now being treated as two separate events. There was inconclusive evidence with regard to the carcass on 08/20/06 to determine mortality due to entanglement.~~

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic humpback whales, January 2005 - December 2009. All records were assumed to involve members of the Gulf of Maine humpback whale stock unless a whale was confirmed to be a member of another stock.

Date[a]	Report Type[b]	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
1/9/2006	mortality	Adult Female #8667 14.0m	off Charleston, SC	P		Extensive muscle hemorrhaging; rib fractures; dislocated flipper on left side of animal
3/17/2006	mortality	Juvenile Female 10.0m	Virginia Beach, VA	P		Crushed cranium and fractured mandible; hemorrhaging associated with fractures; ventral lacerations consistent with propeller wounds
3/25/2006	serious injury	Juvenile sex unknown 8m (est)	Flagler Beach, FL		P	Heavy cyamid load; emaciated; spinal deformity that may or may not have been caused by the entanglement; gear recovered included line and buoys and was identified as lobster pot gear
8/6/2006	serious injury	age & sex unknown	Georges Bank		P	Multiple constricting wraps around head; line cutting into upper lip; wraps around both flippers; no gear recovered
8/23/2006	serious injury	age & sex unknown 12m (est)	Great South Channel		P	Flukes necrotic and nearly severed as a result of entanglement; pale skin and emaciated; gear recovered included heavy line and wire trap
09/06/06[b]	mortality	age & sex unknown	East of Cape Cod, MA		P	Whale entangled through mouth, continuing back to multiple wraps around peduncle; no gear recovered

10/15/2006	mortality	Juvenile Female 10.1m	off Fenwick Island, DE	P	S	Large laceration, penetrating through the bone, across rostrum with accompanying fractures; no gear, but marks around right flipper consistent with entanglement; subdermal hemorrhaging and bone trauma at entanglement point
1/27/2007	serious injury	age & sex unknown	off Beach Haven, NJ	-	P	Body wrap likely to become constricting; random cyamid patches; thin body condition; probable flipper wraps; no gear recovered
5/10/2007	mortality	Adult Female 12.5m	off Wachapreague, VA	P	-	Cranium shattered, hemorrhaging on left lateral side midway between flippers & fluke
5/13/2007	mortality	Juvenile Male 9.3m	Rockport, MA	P	-	Areas of hemorrhaging indicate major blunt trauma to chest, neck, & head
6/23/2007	serious injury	age unknown Male "Egg Toss"	Wildcat Knoll	-	P	Body wrap of gear imbedded; no gear recovered
6/24/2007	mortality	Juvenile Female "Tofu" 9.9m	Stellwagen Bank	P	-	Subdermal hemorrhaging involving blubber, fascia, & muscle extending from/around the insertion of the right flipper ventrally to the axilla
12/21/2007	mortality	age unknown Male 9.4m	Ocean Sands, Corolla, NC	-	P	Documented wrapped in gear, gear removed without permission prior to necropsy; external lesions at flukes, flippers, mouth, dorsal fin, dorsal keel, & ventral pleats consistent with gillnet entanglement; emaciated; no gear recovered
1/6/2008	serious injury	age & sex unknown 10m (est)	off Cape Lookout, NC	-	P	Constricting line cutting into right flipper in several places; heavy cyamid load; emaciated; no gear recovered
5/30/2008	mortality	age & sex unknown	Georges Bank	-	P	Constricting body wraps, one wrap under lower jaw; open wound on right flipper; no gear recovered
6/9/2008	mortality	age & sex unknown	Georges Bank	-	P	Constricting body wrap; gear analysis pending
7/8/2008	serious injury	Adult Female "Estuary"	off Nauset, MA	-	P	Cuts were made, but no gear was removed; emaciated; moderate cyamid coverage; deep wounds in fluke blades from gear; hunched over position maintained after cuts were made to the gear; gear analysis pending

8/13/2008	serious injury	age & sex unknown 10m (est)	off NJ		P	Partial disentanglement; emaciated; lethargic; heavy cyamid load; gear analysis pending
8/21/2008	serious injury	age & sex unknown	off Chatham, MA		P	Evidence of decline in health; no gear recovered
11/4/2008	mortality	Juvenile Male 10.1m	Assateague Island, MD	P		Cranial fractures with associated hemorrhaging
2/8/2009	mortality	age unknown Male 9.7m	Cape Fear, NC		P	Evidence of entanglement at mouthline, peduncle, and flipper with associated hemorrhaging; emaciated; no gear present
2/16/2009	mortality	Juvenile Male 10.0m	Nags Head, NC		P	Evidence of entanglement involving anchoring or heavily weighted gear with associated hemorrhaging; no gear present
2/25/2009	serious injury	Juvenile sex unknown	off Sandy Hook, NJ		P	Disentangled from anchoring pot gear; maintained hunched body position post-disentanglement; gear analysis pending
6/9/2009	serious injury	age & sex unknown	Stellwagen Bank		P	Constricting body wrap just forward of the flippers; no gear recovered

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.

b. Record was added after review of carcasses sighted on 08/20/06 and 09/06/06. Previous reports stated these were the same animal. Recent review could not confirm the resight, therefore they are now being treated as two separate events. There was inconclusive evidence with regard to the carcass on 08/20/06 to determine mortality caused by entanglement.

Other Mortality

Between November 1987 and January 1988, at least 14 humpback whales died after consuming Atlantic mackerel containing a dinoflagellate saxitoxin (Geraci *et al.* 1989). The whales subsequently stranded or were recovered in the vicinity of Cape Cod Bay and Nantucket Sound, and it is highly likely that other unrecorded mortalities occurred during this event. During the first six months of 1990, seven dead juvenile (7.6 to 9.1 m long) humpback whales stranded between North Carolina and New Jersey. The significance of these strandings is unknown.

In July 2003, an Unusual Mortality Event (UME) was invoked in offshore waters when an estimated minimum of 12-15 humpback whales died in the vicinity of the Northeast Peak of Georges Bank. Preliminary tests of samples taken from some of these whales were positive for domoic acid at low levels, but it is currently unknown what levels would affect the whales and therefore no definitive conclusions can yet be drawn regarding the cause of this event or its effect on the status of the Gulf of Maine humpback whale population. Seven humpback whales were considered part of a large whale UME in New England in 2005. Twenty-one dead humpback whales found between 10 July and 31 December 2006 triggered a humpback whale UME declaration~~, still considered ongoing at the end of 2007~~. Causes of these UME events have not been determined.

STATUS OF STOCK

NMFS is currently conducting a global humpback whale status review, which is expected to be completed in 2011. NMFS will include the relevant results of this review in the SARs when they are available. The status of the North Atlantic humpback whale population was the topic of an International Whaling Commission Comprehensive

Assessment in June 2001, and again in May 2002. These meetings conducted a detailed review of all aspects of the population and made recommendations for further research (IWC 2002). Although recent estimates of abundance indicate continued population growth, the size of the humpback whale stock may be below OSP in the U.S. Atlantic EEZ. This is a strategic stock because the humpback whale is listed as an endangered species under the ESA. A Recovery Plan was published and is in effect (NMFS 1991). There are insufficient data to reliably determine current population trends for humpback whales in the North Atlantic overall. The average annual rate of population increase was estimated at 3.1% (SE=0.005, Stevick *et al.* 2003). An analysis of demographic parameters for the Gulf of Maine (Clapham *et al.* 2003) suggested a lower rate of increase than the 6.5% reported by Barlow and Clapham (1997), but results may have been confounded by distribution shifts. The total level of U.S. fishery-caused mortality and serious injury is unknown, but reported levels are more than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant or approaching zero mortality and serious injury rate. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and because the North Atlantic humpback whale is an endangered species.

As part of a large-scale assessment called More of North Atlantic Humpbacks (MoNAH) project, extensive sampling was conducted on humpbacks in the Gulf of Maine/Scotian Shelf region and the primary wintering ground on Silver Bank during 2004-2005. These data are being analyzed along with additional data from the U.S. mid-Atlantic to estimate abundance and refine knowledge of the North Atlantic humpback whales' population structure. The work is intended to update the YONAH population assessment in preparation for a status review under the ESA.

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FIN WHALE (*Balaenoptera physalus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Scientific Committee of the International Whaling Commission (IWC) has proposed stock boundaries for North Atlantic fin whales. Fin whales off the eastern United States, Nova Scotia and the southeastern coast of Newfoundland are believed to constitute a single stock under the present IWC scheme (Donovan 1991). However, the stock identity of North Atlantic fin whales has received relatively little attention, and whether the current stock boundaries define biologically isolated units has long been uncertain. The existence of a subpopulation structure was suggested by local depletions that resulted from commercial overharvesting (Mizroch *et al.* 1984).

A genetic study conducted by Bérubé *et al.* (1998) using both mitochondrial and nuclear DNA provided strong support for an earlier population model proposed by Kellogg (1929) and others. This postulates the existence of several subpopulations of fin whales in the North Atlantic and Mediterranean with limited gene flow among them. Bérubé *et al.* (1998) also proposed that the North Atlantic population showed recent divergence due to climatic changes (i.e., postglacial expansion), as well as substructuring over even relatively short distances. The genetic data are consistent with the idea that different subpopulations use the same feeding ground, a hypothesis that was also originally proposed by Kellogg (1929).

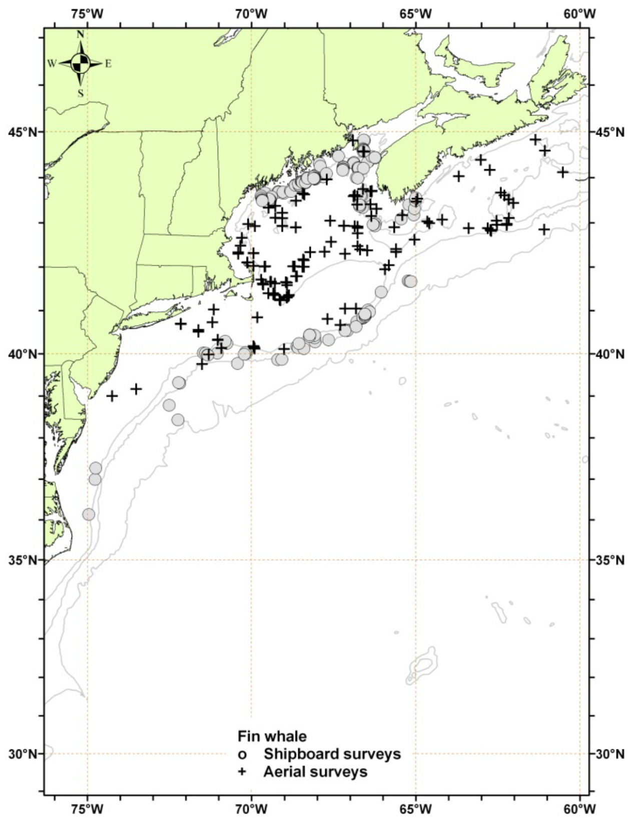

Figure 1. *Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

Fin whales are common in waters of the U. S. Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward (Figure 1). Fin whales accounted for 46% of the large whales and 24% of all cetaceans sighted over the continental shelf during aerial surveys (CETAP 1982) between Cape Hatteras and Nova Scotia during 1978-82. While much remains unknown, the magnitude of the ecological role of the fin whale is impressive. In this region fin whales are probably the dominant large cetacean species during all seasons, having the largest standing stock, the largest food requirements, and therefore the largest impact on the ecosystem of any cetacean species (Hain *et al.* 1992; Kenney *et al.* 1997).

New England waters represent a major feeding ground for fin whales. There is evidence of site fidelity by females, and perhaps some segregation by sexual, maturational or reproductive class in the feeding area (Agler *et al.* 1993). Seipt *et al.* (1990) reported that 49% of fin whales sighted on the Massachusetts Bay area feeding grounds were resighted within the same year, and 45% were resighted in multiple years. The authors suggested that fin whales on these grounds exhibited patterns of seasonal occurrence and annual return that in some respects were similar to those shown for humpback whales. This was reinforced by Clapham and Seipt (1991), who showed maternally-directed site fidelity for fin whales in the Gulf of Maine. Information on life history and vital rates is also available in data from the Canadian fishery, 1965-1971 (Mitchell 1974). In seven years, 3,528 fin whales were taken at three whaling stations. The station at Blandford, Nova Scotia, took 1,402 fin whales.

Hain *et al.* (1992), based on an analysis of neonate stranding data, suggested that calving takes place during October to January in latitudes of the U.S. mid-Atlantic region; however, it is unknown where calving, mating, and wintering occurs for most of the population. Results from the Navy's SOSUS program (Clark 1995) indicate a substantial deep-ocean distribution of fin whales. It is likely that fin whales occurring in the U.S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions. However, the popular notion that entire fin whale populations make distinct annual migrations like some other mysticetes has questionable support in the data; in the North Pacific, year-round monitoring of fin whale calls found no evidence for large-scale migratory movements (Watkins *et al.* 2000).

POPULATION SIZE

The best abundance estimate available for the western North Atlantic fin whale stock is 3,985 (CV=0.24). This is the sum of the estimate derived from the August 2006 Gulf of Maine survey and the estimate derived from the July-August 2007 northern Labrador to Scotian Shelf survey. -The abundance estimates of fin whales include a percentage of the estimate of animals identified as fin/sei whales (the two species being sometimes hard to distinguish). The percentage used is the ratio of positively identified fin whales to the total number of positively identified fin whales and positively identified sei whales.

Earlier abundance estimates

Please see Appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

~~An abundance estimate of 1,716 (CV=0.40) fin whales was obtained from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000-m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)* used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.~~

An abundance estimate of 1,925 (CV=0.55) fin whales was derived from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of trackline in waters north of Maryland (38ºN) (Table 1; Palka 2006). Shipboard data were collected using the two-independent-team line-transect method and analyzed using the modified direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the trackline. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005). The value of *g(0)* used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.

An abundance of 2,269 (CV=0.37) fin whales was estimated from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka pers. comm.). The value of *g(0)* used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 1,716 (CV=0.26) fin whales was generated from the Canadian Trans North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered the area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009).

Table 1. Summary of recent abundance estimates for western North Atlantic fin whales with month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
~~Aug 2002~~	~~S. Gulf of Maine to Maine~~	~~2,933~~	~~0.49~~
Jun-July 2004	Gulf of Maine to lower Bay of Fundy	1,925	0.55
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	2,269	0.37
July-Aug 2007	N. Labrador to Scotian Shelf	1716	0.26
Aug 2006+Jul-Aug 2007	S. Gulf of Maine to N. Labrador (COMBINED)	3,985	0.24

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for fin whales is 3,985(CV=0.24). The minimum population estimate for the western North Atlantic fin whale is 3,269.

Current Population Trend

There are insufficient data to determine population trends for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Based on photographically identified fin whales, Agler *et al.* (1993) estimated that the gross annual reproduction rate was at 8%, with a mean calving interval of 2.7 years.

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 3,269. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, or threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.10 because the fin whale is listed as endangered under the Endangered Species Act (ESA). PBR for the western North Atlantic fin whale is 6.5.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~2004~~ 2005 through ~~2008~~2009, the minimum annual rate of human-caused mortality and serious injury to fin whales was ~~3.2~~ 2.6 per year (U.S. waters, 2.~~4~~0; Canadian waters, 0.~~8~~6). This value includes incidental fishery interaction records, ~~1.2~~0.8 (U.S. waters, ~~1.0~~0.6; Canadian waters, 0.2); and records of vessel collisions, ~~2.0~~1.8 (U.S. waters, 1.4; Canadian waters, 0.~~6~~4)(~~Glass~~ Henry *et al.* ~~2010~~2011~~?~~). Detected mortalities should not be considered an unbiased representation of human-caused mortality. Detections are haphazard and not the result of a designed sampling scheme. As such they represent a minimum estimate of human-caused mortality.

Fishery-Related Serious Injury and Mortality

No confirmed fishery-related mortalities or serious injuries of fin whales have been reported in the NMFS Sea Sampling bycatch database. A review of the records of stranded, floating or injured fin whales for the period ~~2004~~ 2005 through ~~2008~~ 2009 on file at NMFS found ~~three~~ two records with substantial evidence of fishery interactions causing mortality, and ~~three~~ two records resulting in serious injury (Table 2), which results in an annual rate of serious injury and mortality of ~~1.2~~0.8 fin whales from fishery interactions. While these records are not statistically quantifiable in the same way as the observer fishery records, they give a minimum count of entanglements for the species.

Table 2. Confirmed human-caused mortality and serious injury records of western North Atlantic fin whales, January 2004 - December 2008.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
02/12/04	serious injury	age & sex unknown	Pea Island, NC		P	Emaciated; no gear recovered
02/25/04	mortality	Adult Female 16.3m	Port Elizabeth, NJ	P		Displaced vertebrae; ruptured aorta
06/30/04	mortality	age & sex unknown 12m (est)	Georges Bank		P	Freshly dead; heavy line constricting mid-section; no gear recovered
09/26/04	mortality	age & sex unknown 15m (est)	Saint John, NB	P		Fresh carcass on bow of ship
03/26/05	mortality	Adult[c] Female 16.3m	off Virginia Beach, VA	P		Extensive hemorrhaging and vertebral fractures
04/03/05	mortality	Adult[c] Female 18.8m	Southampton, NY	P		Subdermal hemorrhaging
08/23/05	mortality	Juvenile[c] Male 13.7m	Port Elizabeth, NJ	P		Brought in on bow of ship
09/11/05	mortality	Juvenile[c] Male 11.0m	Bonne Esperance, QC	P		Bottom jaw completely severed/broken
09/13/05[d]	mortality	age & sex unknown	Blanc Sablon, Newfoundland	P		Lower jaw broken associated with massive areas of bruising
09/17/06	serious injury	age & sex unknown 18m (est)	off Mt. Desert Rock, ME		P	Pale skin overall; cyamid load at point of attachment; emaciated; no gear recovered
03/25/07	mortality	age unknown Female 18.0m	Norfolk Harbor, VA	P		Extensive fracturing of ribs, skull and vertebrae w/ associated

						hemorrhage & edema
05/24/07	mortality	age unknown Male	Newark Bay, NJ	P		Hemorrhage (epaxial muscle, diaphragm, pleural lining) and multiple fractures of the ribs, vertebrae & sternum and the trailing tissue of the animal was marked by propeller cuts
06/25/07	serious injury	age & sex unknown	Great South Channel		P	Wrap on tail assoc w/ cyamid load; flippers & mouth involved; extremely emaciated; lethargic; no gear recovered
08/11/07	mortality	age & sex unknown	Cabot Strait, Nova Scotia		P	Constricting wrap around body, between the head and flippers; no gear recovered
09/26/07	mortality	Juvenile Male 13m (est)	off Martha's Vineyard, MA		P	Freshly dead, scavenged carcass with gear present; evidence of multiple body wraps with associated hemorrhaging; no gear recovered
07/02/08	mortality	age unknown Male 14.8m	Barnegat Inlet, NJ	P		Vertebral fractures with associated hemorrhaging; hemorrhaging around ball joint of right flipper

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Glass 2010) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.
c. The gender and length were misreported in the 2006 Stock Assessment Report. This table shows the correct values.
d. Additional record which was not included in previous reports.

Table 2. Confirmed human-caused mortality and serious injury records of western North Atlantic fin whales, January 2005 - December 2005.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
3/26/2005	mortality	Adult[b] Female 16.3m	off Virginia Beach, VA	P	-	Extensive hemorrhaging and vertebral fractures

4/3/2005	mortality	Adult[b] Female 18.8m	Southampton, NY	P	-	Subdermal hemorrhaging
8/23/2005	mortality	Juvenile[b] Male 13.7m	Port Elizabeth, NJ	P	-	Fresh carcass on bow of ship; extensive hemmorhaging on right side of body
9/11/2005	mortality	Juvenile[b] Male 11.0m	Bonne-Esperance, QC	P	-	Bottom jaw completely severed/broken
09/13/05[c]	mortality	age & sex unknown	Blanc Sablon, NL	P	-	Lower jaw broken associated with massive areas of bruising
9/17/2006	serious injury	age & sex unknown 18m (est)	off Mt. Desert Rock, ME	-	P	Pale skin overall; cyamid load at point of attachment; emaciated; no gear recovered
3/25/2007	mortality	age unknown Female 18.0m	Norfolk, VA	P	-	Extensive fracturing of ribs, skull, and vertebrae w/ associated hemorrhage & edema
5/24/2007	mortality	age unknown Male	Newark Bay, NJ	P	-	Hemorrhage (epaxial muscle, diaphragm, pleural lining) and multiple fractures of the ribs, vertebrae, & sternum and the trailing tissue of the animal was marked by propeller cuts
6/25/2007	serious injury	age & sex unknown	Great South Channel	-	P	Wrap on tail assoc w/ cyamid load; flippers & mouth involved; extremely emaciated; lethargic; no gear recovered
8/11/2007	mortality	age & sex unknown	Cabot Strait, NS	-	P	Constricting wrap around body, between the head and flippers; no gear recovered
9/26/2007	mortality	Juvenile Male 13m (est)	off Martha's Vineyard, MA	-	P	Freshly dead, scavenged carcass with gear present; evidence of multiple body wraps with associated hemorrhaging; no gear recovered
7/2/2008	mortality	age unknown Male 14.8m	Barnegat Inlet, NJ	P	-	Vertebral fractures with associated hemorrhaging; hemorrhaging around ball joint of right flipper

10/1/2009	mortality	age & sex unknown	Port Elizabeth, NJ	P	-	Fresh carcass with broken flipper, hematomas, and abrasions

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.

b. The gender and length were misreported in the 2006 Stock Assessment Report. This table shows the correct values.

c. Additional record which was not included in previous reports.

Other Mortality

After reviewing NMFS records for ~~2004~~ 2005 through ~~2008~~2009, ~~ten~~ ~~nine~~nine were found that had sufficient information to confirm the cause of death as collisions with vessels (Table 2; ~~Glass~~ Henry *et al.* ~~2010~~2011~~?~~). These records constitute an annual rate of serious injury or mortality of ~~2.0~~1.8 fin whales from vessel collisions. The number of fin whales taken at three whaling stations in Canada from 1965 to 1971 totaled 3,528 whales (Mitchell 1974).

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine the population trend for fin whales. The total level of human-caused mortality and serious injury is unknown. NMFS records represent coverage of only a portion of the area surveyed for the population estimate for the stock. The total U.S. fishery-related mortality and serious injury for this stock derived from the available records is not less than 10% of the calculated PBR, and therefore cannot be considered insignificant and approaching the ZMRG. This is a strategic stock because the fin whale is listed as an endangered species under the ESA. ~~A revised Recovery Plan for fin whales has been published (NMFS 2006).~~

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SEI WHALE (*Balaenoptera borealis borealis*): Nova Scotia Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Mitchell and Chapman (1977) reviewed the sparse evidence on stock identity of northwest Atlantic sei whales, and suggested two stocks—a Nova Scotia stock and a Labrador Sea stock. The range of the Nova Scotia stock includes the continental shelf waters of the northeastern U.S., and extends northeastward to south of Newfoundland. The Scientific Committee of the International Whaling Committee (IWC), while adopting these general boundaries, noted that the stock identity of sei whales (and indeed all North Atlantic whales) was a major research problem (Donovan 1991). In the absence of evidence to the contrary, the proposed IWC stock definition is provisionally adopted, and the "Nova Scotia stock" is used here as the management unit for this stock assessment. The IWC boundaries for this stock are from the U.S. east coast to Cape Breton, Nova Scotia, thence east to longitude 42° W.

Indications are that, at least during the feeding season, a major portion of the Nova Scotia sei whale stock is centered in northerly waters, perhaps on the Scotian Shelf (Mitchell and Chapman 1977). The southern portion of the species' range during spring and summer includes the northern portions of the U.S. Atlantic Exclusive Economic Zone (EEZ) — the Gulf of Maine and Georges Bank. Spring is the period of greatest abundance in U.S. waters, with sightings concentrated along the eastern margin of Georges Bank and into the Northeast Channel area, and along the southwestern edge of Georges Bank in the area of Hydrographer Canyon (CETAP 1982). NMFS aerial surveys ~~in~~ from 1999 on ~~, 2000 and 2001~~ ~~present continue to~~ ~~found~~ ~~find~~have found concentrations of sei and right whales along the ~~Northern~~ northern ~~Edge~~ edge of Georges Bank in the spring. The sei whale is often found in the deeper waters characteristic of the continental shelf edge region (Hain *et al.* 1985), and NMFS aerial surveys found substantial numbers of sei whales in this region, in particular south of Nantucket, in the spring of 2001. Similarly, Mitchell (1975) reported that sei whales off Nova Scotia were often distributed closer to the 2,000-m depth contour than were fin whales.

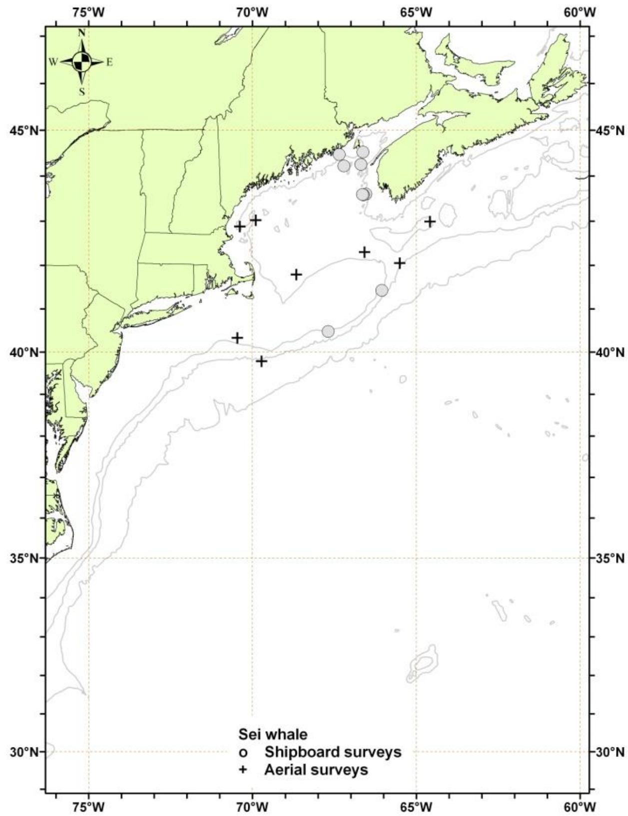

Figure 1. *Distribution of sei whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

This general offshore pattern of sei whale distribution is disrupted during episodic incursions into shallower, more inshore waters. Although known to ~~take piscine prey~~eat fish, sei whales (like right whales) are largely planktivorous, feeding primarily on euphausiids and copepods (Flinn *et al.* 2002). A review by prey preferences by Horwood (1987) showed that in the North Atlantic sei whales seem to prefer copepods over all other prey species. In Nova Scotia sampled stomachs from captured sei whales showed a clear preference for copepods between June and October and euphasiids were taken only in May and November (Mitchell 1975). ~~-~~In years of reduced predation on copepods by other predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the Great South Channel (in 1987 and 1989) and Stellwagen Bank (in 1986) areas (R.D. Kenney, pers. comm.; Payne *et al.* 1990). An influx of sei whales into the southern Gulf of Maine occurred in the summer of

1986 (Schilling *et al.* 1993). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide (Jonsgård and Darling 1977).

Based on analysis of records from the Blandford, Nova Scotia, whaling station, where 825 sei whales were taken between 1965 and 1972, Mitchell (1975) described two "runs" of sei whales, in June-July and in September-October. He speculated that the sei whale population migrates from south of Cape Cod and along the coast of eastern Canada in June and July, and returns on a southward migration again in September and October; however, such a migration remains unverified.

POPULATION SIZE

The total number of sei whales in the U.S. Atlantic EEZ is unknown. However, five abundance estimates are available for portions of the sei whale habitat: from Nova Scotia during the 1970s, in the U.S. Atlantic EEZ during the springs of 1979-1981, and in the U.S. and Canadian Atlantic EEZ during the summers of 2002, 2004, and 2006. The August 2004 abundance estimate (386) is considered the best available for the Nova Scotia stock of sei whales. However, this estimate must be considered conservative in view of the known range of the sei whale in the entire western North Atlantic, and the uncertainties regarding population structure and whale movements between surveyed and unsurveyed areas. The abundance estimates of sei whales include a percentage of the estimate of animals identified as fin/sei whales (the two species being sometimes hard to distinguish). The percentage used is the ratio of positively identified sei whales to the total of positively identified fin whales and positively identified sei whales.

Earlier abundance estimates

Please see appendix IV for earlier abundance estimates. -As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

~~An abundance estimate of 71 (CV=1.01) sei whales was obtained from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000-m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)* used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.~~

An abundance estimate of 386 (CV=0.85) sei whales was derived from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of trackline in waters north of Maryland (38ºN)(Table 1; Palka 2006). There were 6,180 km of trackline within known sei whale habitat, from the 100-m depth contour on southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed. Shipboard data were collected using the two-independent-team line-transect method and analyzed using the modified direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the trackline. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005). The value of *g(0)* used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 207 (CV=0.62) sei whales was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka pers. comm.). The value of *g(0)* used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.

Table 1. Summary of recent abundance estimates for Nova Scotia sei whales with month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
~~Aug 2002~~	~~S. Gulf of Maine to Maine~~	~~71~~	~~1.01~~
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	386	0.85

Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	207	0.62

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by (Wade and Angliss 1997). The best estimate of abundance for the Nova Scotia stock sei whales is 386 (CV=0.85). The minimum population estimate is 208.

Current Population Trend

A population trend analysis has not been done for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a “recovery” factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 208. The maximum productivity rate is 0.04, the default value for cetaceans. The “recovery” factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because the sei whale is listed as endangered under the Endangered Species Act (ESA). PBR for the Nova Scotia stock of the sei whale is 0.4.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~2004~~ 2005 through ~~2008~~2009, the minimum annual rate of human-caused mortality and serious injury to sei whales was 1.~~0~~2. This value includes incidental fishery interaction records, 0.6, and records of vessel collisions, 0.~~4~~ 6 (~~Glass~~ Henry *et al.* ~~2010~~2011). Annual rates calculated from d~~D~~etected mortalities should not be considered an unbiased ~~representation~~ estimate of human-caused mortality. Detections are haphazard, incomplete and not the result of a designed sampling scheme. As such they represent a minimum estimate of human-caused mortality which is almost certainly biased low.

Fishery-Related Serious Injury and Mortality

No confirmed fishery-related mortalities or serious injuries of sei whales have been reported in the NMFS Sea Sampling bycatch database. A review of the records of stranded, floating or injured sei whales for the period ~~2004~~ 2005 through ~~2008~~ 2009 on file at NMFS found 3 records with substantial evidence of fishery interactions causing serious injury (Table 2), which results in an annual rate of serious injury and mortality of 0.6 sei whales from fishery interactions.

Table 2. Confirmed human-caused mortality and serious injury records of Nova Scotian sei whales, ~~2004~~ 2005 - 2009~~8~~.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
04/17/06	mortality	Juvenile Male 10.9m	Baltimore, MD	P		Brought in on bow of ship, freshly dead; massive hemorrhaging on right side; large blood clot behind head; several broken ribs

09/16/06	serious injury	age & sex unknown	Jeffreys Ledge		P	Constricting wrap cutting into skin; no gear recovered
05/30/07	mortality	Adult Female 14.4m	off Deer Island, MA	P		Broken left flipper, 8 vertebral processes, and 4 ribs; right flipper sheared off; lower jaw dislocated; hemorrhaging and/or edema associated with lower jaw and left flipper region
04/09/08	serious injury	age & sex unknown	Great South Channel		P	Constricting wrap on fluke; skin sloughing; no gear recovered
06/29/08	mortality	age & sex unknown 15m (est)	Slacks Cove, New Brunswick		P	Extensive entanglement evident; no gear present
5/19/2009	mortality	Juvenile Male 12.7 m	off Rehobeth Beach, DE	P		Posterior portion of skull & right mandible fractured; hemorrhaging dorsal to left pectoral

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson et al. 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.

Other Mortality

For the period ~~2004~~ 2005 through ~~2008~~ 2009 files at NMFS included ~~two~~ three records with substantial evidence of vessel collisions causing serious injury or mortality (Table 2). Previous NMFS records of human-caused sei whale mortalities include one from 17 November 1994, when a sei whale carcass was observed on the bow of a container ship as it docked in Boston, Massachusetts, and one from 2 May 2001 when the carcass of a 13 m female sei whale slid off the bow of a ship arriving in New York harbor.

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine population trends for sei whales. The total U.S. fishery-related mortality and serious injury for this stock derived from the available records is not less than 10% of the calculated PBR, and therefore cannot be considered insignificant and approaching the ZMRG. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and because the sei whale is listed as an endangered species under the ESA.

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MINKE WHALE (*Balaenoptera acutorostrata acutorostrata*): Canadian East Coast Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Minke whales have a cosmopolitan distribution in temperate and tropical waters. In the North Atlantic, there are four recognized populations—Canadian East Coast, west Greenland, central North Atlantic, and northeastern North Atlantic (Donovan 1991). These divisions were defined by examining segregation by sex and length, catch distributions, sightings, marking data and pre-existing ICES boundaries. However, there were very few data from the Canadian East Coast population.

Minke whales off the eastern coast of the United States are considered to be part of the Canadian East Coast stock, which inhabits the area from the western half of the Davis Strait (45ºW) to the Gulf of Mexico. The relationship between this stock and the other three stocks is uncertain. It is also uncertain if there are separate sub-stocks within the Canadian East Coast stock.

The minke whale is common and widely distributed within the U.S. Atlantic Exclusive Economic Zone (EEZ) (CETAP 1982). There appears to be a strong seasonal component to minke whale distribution. Spring and summer are times of relatively widespread and common occurrence, and when the whales are most abundant in New England waters. In New England waters during fall there are fewer minke whales, while during winter the species appears to be largely absent. Like most other baleen whales, minke whales generally occupy the continental shelf proper, rather than the continental ~~shelf~~ shelf-edge region. Records summarized by Mitchell (1991) hint at a possible winter distribution in the West Indies, and in the mid-ocean south and east of Bermuda. As with several other cetacean species, the possibility of a deep-ocean component to the distribution of minke whales exists but remains unconfirmed.

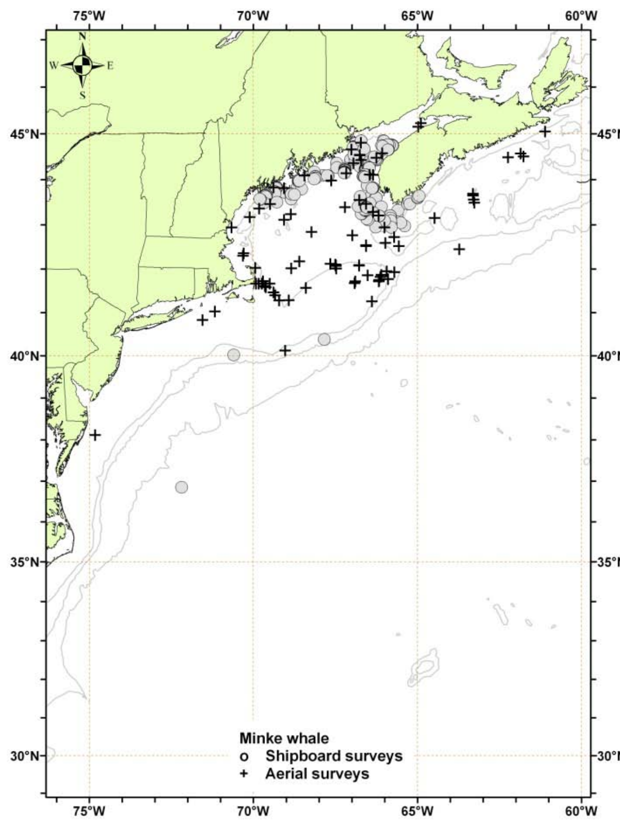

Figure 1. *Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

POPULATION SIZE

The total number of minke whales in the Canadian East Coast population is unknown. However, multiple~~eleven~~ estimates are available for portions of the habitat (see Appendix IV for details on these surveys and estimates). The best recent abundance estimate for this stock is 8,987 (CV=0.32) (Table 2), which is the sum of the August 2006 U.S. survey (3,312 CV=0.74) and the July-August 2007 Canadian survey (5,675 CV=0.25).

Earlier estimates

For earlier abundance estimates please see Appendix IV.

Recent surveys and abundance estimates

~~An abundance estimate of 756 (CV=0.90) minke whales was derived from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000-m depth contour on the southern edge of~~

~~Georges Bank to Maine (Table 1). The value of *g(0)* used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.~~

An abundance estimate of 600 (CV=0.61) minke whales was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the 100-m depth contour on southern Georges Bank to the lower Bay of Fundy. The Scotian Shelf south of Nova Scotia was not surveyed (Table 1; Palka 2006). Shipboard data were collected using the two-independent-team line-transect method and analyzed using the modified direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the trackline. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005). The value of *g(0)* used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 3,312 (CV=0.74) minke whales was generated from an aerial survey conducted in August 2006 which surveyed 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.). The value of *g(0)* used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 5,675 (95%CI=2,214-6,745) minke whales was generated from the Canadian Trans-North Atlantic Sighting Survey (TNASS) in July-August 2007. This survey covered from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009).

Table 1. Summary of abundance estimates for the Canadian east coast stock of minke whales with month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation. (CV).

Month/Year	Area	N_{best}	CV
~~Aug 2002~~	~~S. Gulf of Maine to Maine~~	~~756~~	~~0.90~~
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	600	0.61
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	3,312	0.74
Jul-Aug 2007	N. Labrador to Scotian Shelf	5,675	0.21-0.27
Aug 2006 + Jul-Aug 2007	S. Gulf of Maine to N. Labrador (COMBINED)	8,987	0.32

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for minke whales is 8,987 animals (CV=0.32). The minimum population estimate for the Canadian East Coast minke whale is 6,909 animals.

Current Population Trend

A population trend analysis for this species has not been conducted.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity are that females mature between 6 and 8 years of age, and pregnancy rates are approximately 0.86 to 0.93. Based on these parameters, the calving interval is between 1 and 2 years. Calves are probably born during October to March after 10 to 11 months gestation and nursing lasts for less than 6 months. Maximum ages are not known, but for Southern Hemisphere minke whales maximum age appears to be about 50 years (IWC 1991; Katona *et al.* 1993).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 6,909. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, or threatened stocks, or stocks of unknown status, relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the Canadian east coast minke whale is 69.

ANNUAL HUMAN-CAUSED MORTALITY AND INJURY

During ~~2004~~ 2005 to ~~2008~~2009, the total annual minimum detected average human-caused mortality and serious injury was ~~2.8 4~~5.9 minke whales per year (~~CV=unknown~~3.5 (0.34) minke whales per year from observed US fisheries, ~~). This is derived from three components: 1.2~~ 0.8 minke whales per year (unknown CV) from U.S. fisheries using strandings and entanglement data, 1.2 ~~minke whales per year~~ (unknown CV) from Canadian fisheries using strandings and entanglement data, and ~~and~~ 0.4 ~~minke whales~~ per year from U.S. ship strikes (~~Glass~~ Henry *et al.* ~~2010~~2011~~?~~).

Data to estimate the mortality and serious injury of minke whales come from the Northeast Fisheries Science Center Observer Program and from records of strandings and entanglements in U.S. waters. For the purposes of this report, only those unobserved strandings and entanglement records considered confirmed human-caused mortalities or serious injuries are shown in Table 2, while mortalities and serious injuries recorded by the Observer Program are recorded in Table 3.

Detected mortalities in the strandings and entanglement data should not be considered an unbiased representation of human-caused mortality. Detections are haphazard and not the result of a designed sampling scheme. As such they represent a minimum estimate which is almost certainly biased low.

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

Little information is available about fishery interactions that took place before the 1990s. Read (1994) reported that a minke whale was found dead in a Rhode Island fish trap in 1976. A minke whale was caught and released alive in the Japanese tuna longline fishery in 3,000 m of water, south of Lydonia Canyon on Georges Bank, in September 1986 (Waring *et al.* 1990).

Two minke whales were observed taken in the Northeast sink gillnet fishery. The take in July 1991, south of Penobscot Bay, Maine, was a mortality, and the take in October 1992, off the coast of New Hampshire near Jeffreys Ledge, was released alive.

A minke whale was trapped and released alive from a herring weir off northern Maine in 1990.

Four minke whale mortalities were observed in the Atlantic pelagic drift gillnet fishery during 1995; the fishery closed in 1998.

One minke whale was reported caught in an Atlantic tuna purse seine off Stellwagen Bank in 1991 (D. Beach, NMFS NE Regional Office, pers. comm.) and another in 1996. The minke caught during 1991 was released uninjured after a crew member cut the rope wrapped around the tail. The minke whale caught during 1996 escaped by diving beneath the net.

One minke whale, reported in the strandings and entanglement database, was taken in a 6-inch gill net on 24 June 1998 off Long Island, New York. This take was assigned to the mid-Atlantic gillnet fishery. No minke whales have been taken in this fishery during observed trips in 1993 to ~~2008~~2009.

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, include 36 records of minke whales within U.S. waters for 1975-1992. The gear includes unspecified fishing nets, unspecified cables or lines, fish traps, weirs, seines, gillnets, and lobster gear. One confirmed entanglement was an immature female minke whale, entangled with line around the tail stock, which came ashore on the Jacksonville, Florida jetty on 31 January 1990 (R. Bonde, USFWS, Gainesville, FL, pers. comm.).

The strandings and entanglement database reported 7 minke whale mortalities and serious injuries that were attributed to the Northeast/Mid-Atlantic Lobster Trap/Pot fishery during 1990 to 1994; 1 in 1990 (~~may be~~possible serious injury), 2 in 1991 (1 mortality and 1 serious injury), 2 in 1992 (both mortalities), 1 in 1993 (serious injury) and 1 in 1994 (mortality) (1997 List of Fisheries 62 FR33, 2 January 1997). The one confirmed minke whale mortality during 1995 was attributed to the lobster fishery. No confirmed mortalities or serious injuries of minke whales occurred in 1996. From the four confirmed 1997 records, one minke whale mortality was attributed to the lobster trap fishery. In 2002, one minke whale mortality and one live release were attributed to this fishery. The 28 June 2003 mortality, while wrapped in lobster gear, cannot be confirmed to have become entangled in the area, and so is not attributed to the fishery. Annual mortalities due to the Northeast/Mid-Atlantic Lobster Trap/Pot fishery, as determined from strandings and entanglement records that have been audited, were 1 in 1991, 2 in 1992, 1 in 1994, 1 in 1995, 0 in 1996, 1 in 1997, 0 in 1998 to 2001, 1 in 2002, and 0 in 2003 through ~~2008~~2009.

U.S.

Northeast Bottom Trawl

The fishery is active in New England waters in all seasons. Detailed fishery information is reported in Appendix III. One freshly dead minke whale was caught in 2004 on the northeastern tip of Georges Bank in US waters~~ (Table 2)~~. Two dead minkes were reported by observers in 2008~~ but due to scavenging evidence and emaciation not consistent with the length of the tows, these deaths were not attributed to the fishery~~. Fisheries observer data from the years 2005 through 2009 were pooled and bycatch rates for minke whales were estimated using a stratified ratio-estimator. Estimated bycatch rates from the pooled fisheries observer data were expanded by annual (2005-2009) fisheries data collected from mandatory vessel trip reports. The estimated annual mortality (CV in parentheses) attributed to this fishery was 4.78 (0.75) for 2005, 3.71 (0.73) for 2006, 3.28 (0.72) for 2007, 2.86 (0.73) for 2008, 2.86 (0.75) for 2009. Annual average estimated minke whale mortality and serious injury from the Northeast bottom trawl fishery during 2005 to 2009 was 3.5 (CV=0.34)(Table 3).

~~During 2004 to 2008, as determined from fishery observer as well as strandings and entanglement records, the minimum detected average annual mortality and serious injury is 0.2 minke whales per year in this fishery (Table 2).~~

Unknown Fisheries

~~The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, include 36 records of minke whales within U.S. waters for 1975-1992. The gear include unspecified fishing nets, unspecified cables or lines, fish traps, weirs, seines, gillnets, and lobster gear. One confirmed entanglement was an immature female minke whale, entangled with line around the tail stock, which came ashore on the Jacksonville, Florida jetty on 31 January 1990 (R. Bonde, USFWS, Gainesville, FL, pers. comm.).~~

The audited NE Regional Office/NMFS entanglement/stranding database contains records of minke whales, of which the confirmed mortalities and serious injuries from the last five years are reported in Table 2. Mortalities (and serious injuries) that were likely a result of a U.S. fishery interaction with an unknown fishery include 3 (0) in 1997, 3 (0) in 1999, 1 (1) in 2000, 2 (0) in 2001, 1 (0) in 2002, 5 (0) in 2003, 2 (0) in 2004, 0 (0) in 2005, 0 (0) in 2006, 1 (1) in 2007, ~~and~~ 1 (0) in 2008, and 0 (1) in 2009 (Table 2). During ~~2004~~ 2005 to ~~2008~~200~~5~~9, as determined from strandings and entanglement records, the minimum detected average annual mortality and serious injury is ~~1.0~~0.8 minke whales per year in unknown U.S. fisheries (Table 2).

CANADA

Read (1994) reported interactions between minke whales and gillnets in Newfoundland and Labrador, in cod traps in Newfoundland, and in herring weirs in the Bay of Fundy. Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on between 25% and 40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. During 1991 through 1996, no minke whales were observed taken.

Herring Weirs

During 1980 to 1990, 15 of 17 minke whales were released alive from herring weirs in the Bay of Fundy. During January 1991 to September 2002, 26 minke whales were trapped in herring weirs in the Bay of Fundy. Of these 26, 1 died (H. Koopman, pers. comm.) and several (number unknown) were released alive and unharmed (A. Westgate, pers. comm.). Four minkes were reported released alive from Gran Manan herring weirs in 2009 (H. Koopman pers. comm.).

Other Fisheries

Six minke whales were reported entangled during 1989 in the groundfish gillnet fishery in Newfoundland and Labrador (Read 1994). One of these animals escaped and was still towing gear, the remaining five animals died.

Salmon gillnets in Canada, now no longer used, had taken a few minke whales. In Newfoundland in 1979, one minke whale died in a salmon net. In Newfoundland and Labrador, between 1979 and 1990, it was estimated that 15% of the Canadian minke whale takes were in salmon gillnets. A total of 124 minke whale interactions were documented in cod traps, groundfish gillnets, salmon gillnets, other gillnets, and other traps. The salmon gillnet fishery ended in 1993 as a result of an agreement between the fishermen and North Atlantic Salmon Fund (Read 1994).

Five minke whales were entrapped and died in Newfoundland cod traps during 1989. The cod trap fishery closed in Newfoundland in 1993 due to the depleted groundfish resources (Read 1994).

In 2004, two minke whales were reported dead in entangled fishing gear off of Newfoundland and Labrador, one in a blackback flounder net, and one in crab gear (Ledwell and Huntington 2004). Only the flounder net animal had enough information to include it as a human-caused mortality. In 2005, four minke whales were reported entangled in fishing gear in Newfoundland and Labrador. Two (entangled in salmon net and mackerel trap gear) were released alive and two (involved with whelk pot and toad crab pot fisheries) were dead (Ledwell and Huntington 2006). The whelk pot mortality could not be conclusively attributed to human causes. In 2006, one minke whale was reported dead in a mackerel trap off of Newfoundland (Ledwell and Huntington 2007). In 2007, four minke whales in Newfoundlandland and Labrador were reported entangled, but released alive (Ledwell and Huntington 2008). In 2008, four minkes were reported entangled in Newfoundland and Labrador. Two of these were dead and two were released alive, though one of the live releases was listed as 'condition uncertain" (Ledwell and Huntington 2009). In 2008, one minke was reported dead in an unknown fishery off of New Brunswick. In 2009, one minke whale was determined to have been seriously injured off of Quebec. Mortalities (and serious injuries) that were likely a result of a anCanadian fishery interaction with an unknown Canadian fishery include 1(0) in 2004, 1(0) in 2005, 1(0) in 2006, 0(0) in 2007, and 3(0) in 2008, and 0 (1) in 2009. During 2004 2005 to 20082009, as determined from Canadian strandings and entanglement records, the minimum detected average annual mortality and serious injury was 1.2 minke whales per year in fisheries (Table 2).

Table 2. Confirmed U.S. and Canadian human-caused mortality and serious injury records of Canadian East Coast stock of minke whales, January 2004 through December 2008.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh. Inter.	
05/06/04	mortality	Adult Female 7.7m	Martha's Vineyard, MA		P	Unknown fishery; constricting line marks on peduncle; indications of drowning from internal exam; no gear present
06/01/04	mortality	Juvenile Female 6.5m	Chatham, MA	P		Large area of subdermal hemorrhaging
07/19/04	mortality	Adult Female 7.9m	Eastham, MA		P	Unknown fishery; extensive entanglement markings; no gear recovered

08/04	mortality	age & sex unknown 4m (est)	Georges Bank, USA		P	Northeast Bottom Trawl; fresh dead, rigid, had to cut out of net, rope in mouth; from fisheries observer records
08/09/04[€]	mortality	age & sex unknown	Cape Broyle Head, Newfoundland		P	Blackback flounder net; partial disentanglement; fishermen witnessed death of animal in remaining gear
05/23/05	mortality	Juvenile Male 5.9m	Port Elizabeth, NJ	P		Ribs shattered; liver ruptured; evidence of internal hemorrhaging
08/24/05[€]	mortality	age & sex unknown	Bridgeport, New World Island, Newfoundland		P	Toad crab pots; constricting gear through mouth with flipper and tail wraps
09/22/06[€]	mortality	age & sex unknown	Woods Cove, Northern Peninsula, Newfoundland		P	Mackerel trap; anchored by tail in doorways of the gear
07/16/07	serious injury	age & sex unknown 10m (est)	Trescott, ME		P	Unknown fishery; wrapped in gear and anchored; no gear recovered
08/05/07	mortality	Juvenile Female 4.3m	Cape Cod Bay, MA		P	Unknown fishery; chronic entanglement with severe emaciation and dehydration and loss of protein; line lacerated blubber layer across back and at flipper insertions; severe hemorrhage and necrosis of blubber at gear entanglement points; gear consists of 11/16" diameter floating rope
06/14/08	mortality	Juvenile Female 4.7m	Orleans, MA		P	Unknown fishery; braided line impressions wrapped the body in 3 places and left a deep, hemorrhaged laceration across the rostrum and blowholes; hemorrhaged abrasions present on roof of mouth; wet, blood-filled lungs indicate drowning; no gear present
07/23/08	mortality	age & sex unknown 7m (est)	Kelligrews, Newfoundland		P	Unknown fishery; constricting wraps of gear on caudal peduncle; 5/8" polypropylene rope
07/26/08	mortality	age & sex unknown	Conception Bay, Newfoundland		P	Blackback flounder net; constricting wraps of gear through mouth and around tail

08/25/08	mortality	age & gender unknown 8m (est)	off Richibucto Cape, New Brunswick		P	Unknown fishery; evidence of constricting body wraps; gear not recovered

			ship strike	**entanglement**	
5-year totals	**US waters**	**serious injury**	**0**	**1**	
		mortality	**2**	**5**	
	Canadian waters	**serious injury**	**0**	**0**	
		mortality	**0**	**6**	

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Glass *et al.* 2009; Glass 2010) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.
c.a. Additional record which was not included in previous reports.

Table 2. Confirmed U.S. and Canadian human-caused mortality and serious injury records of Canadian East Coast stock of minke whales, January 2005 through December 2009.

Date[a]	**Report Type[b]**	**Age, Sex, Length**	**Location[a]**	**Assigned Cause: P=primary, S=secondary**		**Notes/Observations**
				Ship strike	**Entang./ Fsh. Inter.**	
5/23/2005	mortality	Juvenile Male 5.9m	Port Elizabeth, NJ	P	-	Ribs shattered; liver ruptured; evidence of internal hemorrhaging
08/24/2005[b] [c]	mortality	age & sex unknown	Bridgeport, New World Island, Newfoundland	-	P	Constricting gear through mouth with flipper and tail wraps; toad crab pots
09/22/2006[b] [c]	mortality	age & sex unknown	Woods Cove, Great Northern Peninsula, Newfoundland	-	P	Anchored by tail in doorways of the gear; mackerel trap
7/16/2007	serious injury	age & sex unknown 10m (est)	Trescott, ME	-	P	Wrapped in gear and anchored; no gear recovered

8/5/2007	mortality	Juvenile Female 4.3m	Cape Cod Bay, MA	-	P	Chronic entanglement with severe emaciation and dehydration and loss of protein; line lacerated blubber layer across back and at flipper insertions; severe hemorrhage and necrosis of blubber at gear entanglement points; gear consists of 11/16" diameter floating rope
6/14/2008	mortality	Juvenile Female 4.7m	Orleans, MA	-	P	Braided line impressions wrapped the body in 3 places and left a deep, hemorrhaged laceration across the rostrum and blowholes; hemorrhaged abrasions present on roof of mouth; wet, blood-filled lungs indicate drowning; no gear present
7/23/2008	mortality	age & sex unknown 7m (est)	Kelligrews, Newfoundland	-	P	Constricting wraps of gear on caudal peduncle; 5/8" polypropylene rope
7/26/2008	mortality	age & sex unknown	Conception Bay, Newfoundland	-	P	Constricting wraps of gear through mouth and around tail; blackback flounder nets
8/25/2008	mortality	age & sex unknown 8m (est)	off Richibucto Cape, New Brunswick	-	P	Evidence of constricting body wraps; gear not recovered
5/20/2009	mortality	Adult sex unknown 8m (est)	off Point Pleasant, NJ	P	-	Large hemorrhage at right pectoral
6/3/2009	serious injury	age & sex unknown	off Tadoussac, Quebec	-	P	Free-swimming with tight rostrum wrap; no gear recovered
8/11/2009	serious injury	age & sex unknown	off Plymouth, MA	-	P	Constricting wrap on rostrum & poor skin condition; no gear recovered

			ship strike	**entanglement**	
5-year totals	**US waters**	**serious injury**	**0**	**2**	
		mortality	**2**	**2**	
	Canadian waters	**serious injury**	**0**	**~~0~~1**	
		mortality	**0**	**~~6~~5**	

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.

b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (~~Glass *et al.* 2009; Glass 2010~~Henry *et al.* 2011) have been used here. -Some assignments may change as new information becomes available and/or when national standards are established.

c. Additional record which was not included in previous reports.

Table 3. Summary of the incidental mortality of Canadian East Coast stock of minke whales (*Balaenoptera acutorostrata acutorostrata*) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery [a]	Years	Data Type [b]	Observer Coverage [c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Northeast Bottom Trawl [d]	05-09	Obs. Data Dealer Data VTR Data	.12, .06, .06, .08, .09	0, 0, 0, 0, 0	0, 0, 0, 2, 0	0, 0, 0, 0, 0	4.8, 3.7, 3.3, 2.9, 2.9	4.8, 3.7, 3.3, 2.9, 2.9	.75, .73, .72, .73, .75	3.5 (.34)
TOTAL										3.5 (.34)

a. Fisheries observer data from the years 2005 through 2009 were pooled and bycatch rates for minke whales were estimated using a stratified ratio-estimator. Estimated bycatch rates from the pooled fisheries observer data were expanded by annual (2005-2009) fisheries data collected from mandatory vessel trip reports .

Other Mortality

Minke whales have been and continue to be hunted in the North Atlantic. From the Canadian East Coast population, documented whaling occurred from 1948 to 1972 with a total kill of 1,103 animals (IWC 1992). Animals from other North Atlantic minke populations are presently still being harvested.

U.S.

Minke whales inhabit coastal waters during much of the year and are thus subject to collision with vessels. According to the NMFS/NER marine mammal entanglement and stranding database, on 7 July 1974, a necropsy of a minke whale suggested a vessel collision; on 15 March 1992, a juvenile female minke whale with propeller scars was found floating east of the St. Johns Channel entrance (R. Bonde, USFWS, Gainesville, FL, pers. comm.); and on 15 July 1996 the captain of a vessel reported hitting a minke whale offshore of Massachusetts. After reviewing this record, it was concluded the animal struck was not a serious injury or mortality. On 12 December 1998, a minke whale was struck and presumed killed by a ~~whale~~ whale-watching vessel in Cape Cod Bay off Massachusetts.

During 1999 to 2003, no minke whale was confirmed struck by a ship. During 2004 and 2005, one minke whale mortality was attributed to ship strike in each year (Table 2). During 2006 to 2008, no minke whale was confirmed struck by a ship. During 2009, one minke whale was confirmed dead due to a ship strike off of New Jersey. Thus, during ~~2004~~ 2005 to ~~2008~~2009, as determined from stranding and entanglement records, the minimum detected annual average was 0.4 minke whales per year struck by ships.

In October 2003, an Unusual Mortality Event was declared involving minke whales and harbor seals along the coast of Maine; since then, the number of minke whale stranding reports has returned to normal. ~~There were two minke whale stranding mortalities in NC in 2005 but in neither case could cause of death be attributed to human causes (Glass *et al.* 2008). There were 7 minke whale stranding mortalities reported along the US Atlantic coast in 2006. Three were in New Jersey, one in Massachusetts, one in Rhode Island, and two in the EEZ. One of the stranding mortalities from New Jersey was reported with signs of human interaction due to pieces of plastic found in the stomach.~~Stranding mortalities and serious injuries that have been determined to be human-caused are included in Table 2 (Henry *et al.* 2011).

On 11 October 2009, the NOAA research vessel FSV Delaware II captured a minke whale during mid-water trawling operations associated with the 2009 Atlantic Herring Acoustics survey. Although brought on deck, the animal was released alive and appeared to exhibit healthy behavior upon release.

CANADA

The Nova Scotia Stranding Network documented whales and dolphins stranded on the coast of Nova Scotia between 1991 and 1996 (Hooker *et al.* 1997). Researchers with the Department of Fisheries and Oceans, Canada documented strandings on the beaches of Sable Island (Lucas and Hooker 2000). Sable Island is approximately 170 km southeast of mainland Nova Scotia. Lucas and Hooker (2000) reported 4 minke whales stranded on Sable Island between 1970 and 1998, 1 in spring 1982, 1 in January 1992, and a mother/calf in December 1998. On the mainland of Nova Scotia, a total of 7 ~~reported~~ minke whales stranded during 1991 to 1996. The 1996 stranded minke whale was released alive off Cape Breton on the Atlantic Ocean side, the rest were found dead. All the minke whales stranded between July and October. One was from the Atlantic Ocean side of Cape Breton, 1 from Minas Basin, 1 was at an unknown location, and the rest stranded in the vicinity of Halifax, Nova Scotia. It is unknown how many of the strandings resulted from fishery interactions.

Whales and dolphins stranded between 1997 and ~~2008~~ 2009 on the coast of Nova Scotia as recorded by the Marine Animal Response Society (MARS) and the Nova Scotia Stranding Network are as follows: 4 minke whales stranded in 1997, 0 documented strandings in 1998 to 2000, 1 in September 2001, 4 in 2002, 2 in 2003, 0 in 2004, 3 in 2005, 8 in 2006, 1 in 2007, ~~and~~ 4 (including the entangled animal listed in Table 2) in 2008, and 5 in 2009 (including one minke released alive from a weir).

The Whale Release and Strandings program has reported ten minke whale stranding mortalities in Newfoundland and Labrador between ~~2004~~ 2005 and ~~2008~~2009, ~~-~~; 3 in 2005, 1 in 2006, 2 in 2007, 3 in 2008, 1 in 2009. ~~five~~ Four of ~~which~~ these records are included in Table 2 (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009~~.~~; 2010).

STATUS OF STOCK

The status of minke whales, relative to OSP, in the U.S. Atlantic EEZ is unknown. The minke whale is not listed as endangered under the Endangered Species Act (ESA). The total U.S. fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because estimated human-related mortality and serious injury does not exceed PBR and the minke whale is not listed as a threatened or endangered species under the ESA.

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~~November 2010~~April 2011

RISSO'S DOLPHIN (*Grampus griseus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are distributed worldwide in tropical and temperate seas, and in the Northwest Atlantic occur from Florida to eastern Newfoundland (Leatherwood *et al.* 1976; Baird and Stacey 1990). Off the northeastern U.S. coast, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank during spring, summer, and autumn (CETAP 1982; Payne *et al.* 1984). In winter, the range is in the mid-Atlantic Bight and extends outward into oceanic waters (Payne *et al.* 1984)~~–~~. In general, the population occupies the mid-Atlantic continental shelf edge year round, and is rarely seen in the Gulf of Maine (Payne *et al.* 1984)~~-~~. During 1990, 1991 and 1993, spring/summer surveys conducted along the continental shelf edge and in deeper oceanic waters sighted Risso's dolphins associated with strong bathymetric features, Gulf Stream warm-core rings, and the Gulf Stream north wall (Waring *et al.* 1992; 1993; Hamazaki 2002)~~–~~. There is no information on stock structure of Risso's dolphin in the western North Atlantic, or to determine if separate stocks exist in the Gulf of Mexico and Atlantic. In 2006, a rehabilitated adult male Risso's dolphin stranded and released in the Gulf of Mexico off Florida was tracked via satellite to waters off Delaware (Wells *et al.* ~~2008b~~2009). The Gulf of Mexico and Atlantic stocks are currently being treated as two separate stocks.

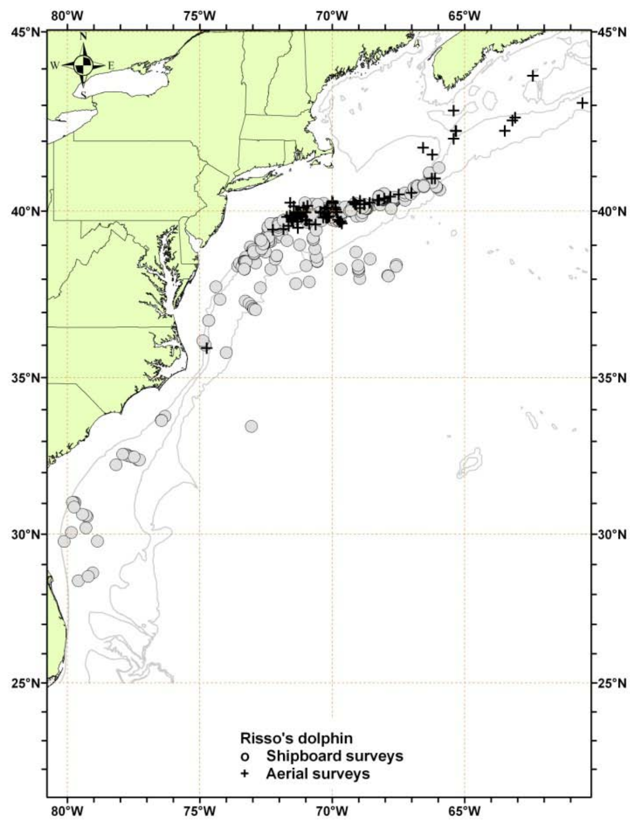

Figure 1. *Distribution of Risso's dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 ,2006 and 2007. Isobaths are the 100-m, 1,000-m, and 4,000-m depth contours.*

POPULATION SIZE

Total numbers of Risso's dolphins off the U.S. or Canadian Atlantic coast are unknown, although eight abundance estimates are available from selected regions for select time periods. Sightings were almost exclusively in continental shelf edge and continental slope areas (Figure 1). The best abundance estimate for Risso's dolphins is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 20,479 (CV=0.59), where the estimate from the northern U.S. Atlantic is 15~~.~~,053 (CV=0.78), and from the southern U.S. Atlantic is 5,426 (CV=0.54). This joint estimate is considered best because these two surveys together have the most complete coverage of the population's habitat.

Earlier abundance estimates

Please see appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, therefore should not be used for PBR determinations. Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates.

Recent surveys and abundance estimates

~~An abundance estimate of 9,311 (CV=0.76) Risso's dolphins was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1,000-m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of g(0) used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.~~

An abundance estimate of 15,054 (CV=0.78) Risso's dolphins was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Table 1; Palka 2006). Shipboard data were collected using the two-independent-team line-transect method and analyzed using the modified direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005) .

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths >50 m) between Florida and Maryland (27.5~~ and ~~–38ºN latitude) was conducted during June-August 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and recorded a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were analyzed to correct for visibility bias (*g(0)*) and group-size bias employing line-transect distance analysis and the direct-duplicate estimator (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for Risso's dolphins between Florida and Maryland was 5,426 (CV =0.54).

An abundance estimate of 14,408 (CV=0.38) Risso's dolphins was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2,000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka, pers. comm.). The value of g(0) used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.

Table 1. Summary of abundance estimates for the western North Atlantic Risso's dolphin. Month, year, and area covered during each abundance survey, resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
~~Aug 2002~~	~~Georges Bank to Maine coast~~	~~9,311~~	~~0.76~~
Jun-Aug 2004	Maryland to Bay of Fundy	15,053	0.78
Jun-Aug 2004	Florida to Maryland	5,426	0.54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	20,479	0.59
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	14,408	0.38

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for Risso's dolphins is 20,479 (CV=0.59), obtained from the 2004 surveys. The minimum population estimate for the western North Atlantic Risso's dolphin is 12,920.

Current Population Trend

There are insufficient data to determine population trends for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995)~~.~~.

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 12,920. The maximum productivity rate is 0.04, the default value for cetaceans (Barlow *et al.* 1995). The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.48 because the CV of the average mortality estimate is between 0.3 and 0.6 (Wade and Angliss 1997). PBR for the western North Atlantic stock of Risso's dolphin is 124.

ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality or serious injury to this stock during ~~2004~~2005-~~2008~~ 2009 was ~~21~~ 18 Risso's dolphins (CV=0.~~35~~37; Table 2).

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeastern coast of the U.S. With implementation of the Fisheries Conservation and Management Act in that year, an observer program was established which recorded fishery data and information on incidental bycatch of marine mammals. NMFS foreign-fishery observers reported four deaths of Risso's dolphins incidental to squid and mackerel fishing activities in the continental shelf and continental slope waters between March 1977 and December 1991 (Waring *et al.* 1990; NMFS unpublished data) .

In the pelagic drift gillnet fishery, 51 Risso's dolphin mortalities were observed between 1989 and 1998. One animal was entangled and released alive. Bycatch occurred during July, September and October along continental shelf edge canyons off the southern New England coast. Estimated annual mortality and serious injury (CV in parentheses) attributable to the drift gillnet fishery was 87 in 1989 (0.52), 144 in 1990 (0.46), 21 in 1991 (0.55), 31 in 1992 (0.27), 14 in 1993 (0.42), 1.5 in 1994 (0.16), 6 in 1995 (0), 0 in 1996, no fishery in 1997, and 9 in 1998 (0). This fishery was closed effective in 1999.

In the pelagic pair trawl fishery, one mortality was observed in 1992. Estimated annual fishery-related mortality (CV in parentheses) attributable to the pelagic pair trawl fishery was 0.6 dolphins in 1991 (1.0), 4.3 in 1992 (0.76), 3.2 in 1993 (1.0), 0 in 1994 and 3.7 in 1995 (0.45). This fishery ended as of 1996.

Pelagic Longline

Pelagic longline bycatch estimates of Risso's dolphins in 1998, 1999, and 2000 were obtained from Yeung (1999), Yeung *et al.* (2000), and Yeung (2001), respectively. Bycatch estimates for 2001 - ~~2008~~ 2009 were obtained from Garrison (2003), Garrison and Richards (2004), Garrison (2005), Fairfield Walsh and Garrison (2006), Fairfield Walsh and Garrison (2007), Fairfield and Garrison (2008), ~~and (~~Garrison *et al.* (2009) and Garrison and

Stokes (2010). Most of the estimated marine mammal bycatch was from U.S. Atlantic EEZ waters between South Carolina and Cape Cod. Excluding the Gulf of Mexico, from 1992 to 2000 one mortality was observed in both 1994 and 2000, and 0 in other years. The observed numbers of seriously-injured but released alive individuals from 1992 to 2008 were, respectively, 2, 0, 6, 4, 1, 0, 1, 1, 1, 6, 4, 2, 2, 0, 0, 1 and 3 (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999; Yeung 1999; Yeung *et al.* 2000; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007; Fairfield and Garrison 2008) (Table 2). Estimated annual fishery-related mortality (CV in parentheses) was 17 animals in 1994 (1.0), 41 in 2000 (1.0), 24 in 2001(1.0), 20 in 2002 (0.86), and 0 in 2003 to 2008 (Table 2). Seriously injured and released alive animals were estimated to be 54 dolphins (0.7) in 1992, 0 in 1993, 120 (0.57) in 1994, 103 (0.68) in 1995, 99 (1.0) in 1996, 0 in 1997, 57 (1.0) in 1998, 22 (1.0) in 1999, 23 (1.0) in 2000, 45 (0.7) in 2001, 8 (1.0) in 2002, 40 (0.63) in 2003 28(0.72) in 2004, 3(1.0), 0 in 2005, 0 in 2006, 9 in 2007, and 17 in 2008 (Table 2). There is a high likelihood that dolphins released alive with ingested gear or gear wrapped around appendages will not survive (Wells *et al.* 2008a). The annual average combined mortality and serious injury for ~~2004~~2005-~~2008~~ 2009 is ~~11~~ 8 Risso's dolphins (CV =0.~~43~~40; Table 2).

Northeast Sink Gillnet

Estimated annual mortalities (CV in parentheses) from this fishery are: 0 in 1999, 15 (1.06) in 2000, 0 in 2001-2004, 15 in 2005 (0.93), and 0 in 2006 through ~~2008~~ 2009 (Table 2). The ~~2004~~2005-~~2008~~ 2009 average mortality in this fishery is 3 Risso's dolphins (CV =0.93).

Mid-Atlantic Gillnet

A Risso's dolphin mortality was observed in this fishery for the first time in 2007. The resulting estimated annual mortality for 2007 was 34 (CV=0.73). ~~–~~The ~~2004~~2005-~~2008~~ 2009 average mortality in this fishery is 7 Risso's dolphins (CV=0.73).

Mid-Atlantic Mid-water Trawl

A Risso's dolphin mortality was observed in this fishery for the first time in 2008. No bycatch estimate has been generated.

Table 2. Summary of the incidental mortality of Risso's dolphin (*Grampus griseus*) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline [b]	05~~4~~-~~08~~09	Obs. Data Logbook	~~.09,~~ .06, .07, .07, .07, .14	~~2,~~ 0, 0, 1, 2, 2	~~0,~~ 0, 0, 0, 0, 0	~~28,~~ 3, 0, 9, 17, 11	~~0,~~ 0, 0, 0, 0. 0	~~28,~~ 3, 0, 9, 17, 11	~~.72,~~ 1, 0, .65, .73, .71	~~11~~ 8(0.4~~3~~0)
Northeast Sink Gillnet	~~04~~05-~~08~~09	Obs. Data Trip Logbook, Allocated Dealer Data	~~.06, .07,~~ 04, .07, .05, .04	0, 0, 0, 0, 0	~~0,~~ 1, 0, 0, 0, 0	0, 0, 0, 0, 0	~~0,~~ 15, 0, 0, 0, 0	~~0,~~ 15, 0, 0, 0, 0	~~0,~~ 0.93, 0, 0, 0, 0	3 (0.93)
Mid-Atlantic Gillnet	~~04~~05-~~08~~09	Obs. Data, Trip Logbook, Allocated Dealer Data	~~.02,~~ .03, .04, .04, .03, .03	0, 0, 0, 0, 0	~~0,~~ 0, 0, 1, 0, 0	0, 0, 0, 0, 0	~~0,~~ 0, 0, 34, 0, 0	~~0,~~ 0, 0, 33, 0, 0	~~0,~~ 0, 0, .73, 0, 0	7 (0.73)
Mid-Atlantic Midwater Trawl - Including Pair Trawl	~~04~~05-~~08~~09	Obs. Data Weighout Trip Logbook	~~.064,~~ .084, .089, .039, .133, .132	0,0,0,0,0	~~0,~~0,0,0,1, 0	na	na	na	na	na

TOTAL		~~21~~ 18 (0.~~35~~37)
[a]	Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program. The Observer Program collects landings data (Weighout), and total landings are used as a measure of total effort for the coastal gillnet fishery.	
[b]	Estimates can include data pooled across years, so years without observed SI or Mortality may still have an estimated value.	

Other mortality

From ~~2004~~ 2005 to ~~2008~~2009, ~~71~~ 66 Risso's dolphin strandings were recorded along the U.S. Atlantic coast (NMFS unpublished data). ~~Three~~ Six animals during this time period had indications of human interaction, ~~two~~ four of which were fishery interactions. Indications of human interaction are not necessarily the cause of death. In eastern Canada, one Risso's dolphin stranding was reported on Sable Island, Nova Scotia ~~from~~ between 1970 ~~to1998~~ and 1998 (Lucas and Hooker 2000).

A Virginia Coastal Small Cetacean Unusual Mortality Event (UME) occurred along the coast of Virginia from 1 May to 31 July 2004, when 66 small cetaceans, including one Risso's dolphin, stranded mostly along the outer (eastern) coast of Virginia's barrier ~~islands~~ islands.

A Mid-Atlantic Offshore Small Cetacean UME was declared when 33 small cetaceans stranded from Maryland to Georgia between July and September 2004. The species involved are generally found offshore and are not expected to strand along the coast. Three Risso's dolphins were involved in this UME.

~~Table 3. Risso's dolphin (*Grampus griseus*) reported strandings along the U.S. Atlantic coast, 2004-2008.~~

~~STATE~~	~~2004~~	~~2005~~	~~2006~~	~~2007~~	~~2008~~	~~TOTALS~~
~~Maine~~	~~2~~	~~-~~	~~1~~	~~-~~	~~1~~	~~4~~
~~Massachusetts[a,d]~~	~~4~~	~~8~~	~~1~~	~~3~~	~~8~~	~~24~~
~~Rhode Island~~	~~1~~	~~1~~	~~-~~	~~-~~	~~-~~	~~2~~
~~New York~~	~~3~~	~~4~~	~~1~~	~~-~~	~~-~~	~~8~~
~~New Jersey~~	~~-~~	~~5~~	~~-~~	~~2~~	~~-~~	~~7~~
~~Delaware~~	~~1~~	~~1~~	~~-~~	~~1~~	~~-~~	~~3~~
~~Maryland~~	~~1~~	~~2~~	~~1~~	~~-~~	~~1~~	~~5~~
~~Virginia[b]~~	~~1~~	~~4~~	~~1~~	~~1~~	~~-~~	~~7~~
~~North Carolina[c]~~	~~2~~	~~2~~	~~1~~	~~-~~	~~1~~	~~6~~
~~Florida~~	~~3~~	~~-~~	~~-~~	~~1~~	~~-~~	~~4~~
~~EZ~~	~~1~~	~~-~~		~~-~~	~~-~~	~~1~~
~~TOTAL~~	~~19~~	~~27~~	~~6~~	~~8~~	~~11~~	~~71~~

~~a. One of the 2004 animals was mutilated, fluke cut off.~~
~~b. One of the 2005 animals showed signs of fishery interaction.~~
~~c. One of the 2006 animals showed signs of fishery interaction.~~
~~d. 2008 includes 4 animals mass stranded in Massachusetts, 3 of which were released alive.~~

Table 3. Risso's dolphin (*Grampus griseus*) reported strandings along the U.S. Atlantic coast, 2005-2009.

STATE	**2005**	**2006**	**2007**	**2008**	**2009**	**TOTALS**
Maine	_	1	_	1	1	3
Massachusetts[a,d]	8	1	3	8	4	24
Rhode Island	1	_	_	_	_	1

New York	4	1	-	-	-	5
New Jersey	5	-	2	-	-	7
Delaware	1	-	1	-	-	2
Maryland	2	1	-	1	1	5
Virginia[b]	4	1	1	-	2	8
North Carolina[c]	2	1	-	1	3	7
Georgia	-	-	-	-	1	1
Florida[e]	-	-	1	-	2	3
TOTAL	27	6	8	11	14	66

a. One of the 2009 animals had propeller wounds.

b. One of the 2005 animals showed signs of fishery interaction. One of the 2009 animals showed signs of human interaction.

c. One animal in 2006 and 2 in 2009 showed signs of fishery interaction.

d. 2008 includes 4 animals mass stranded in Massachusetts, 3 of which were released alive.

e. The 2 animals in 2009 were considered a mass stranding.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

STATUS OF STOCK

The status of Risso's dolphins relative to OSP in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this species. The total U.S. fishery mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching a zero mortality and serious injury rate. The ~~2004~~2005-~~2008~~ 2009 average annual human-related mortality does not exceed PBR; therefore, this is not a strategic stock.

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LONG-FINNED PILOT WHALE (*Globicephala melas melas*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are 2 species of pilot whales in the western Atlantic—the long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea; therefore, the ability to separately assess the 2 stocks in U.S. Atlantic waters is limited. The long-finned pilot whale is distributed from North Carolina to North Africa (and the Mediterranean) and north to Iceland, Greenland and the Barents Sea (Sergeant 1962; Leatherwood *et al.* 1976; Abend 1993; Buckland *et al.* 1993; Abend and Smith 1999). The stock structure of the North Atlantic population is uncertain (ICES 1993; Fullard *et al.* 2000). Morphometric (Bloch and Lastein 1993) and genetic (Siemann 1994; Fullard *et al.* 2000) studies have provided little support for stock structure across the Atlantic (Fullard *et al.* 2000). However, Fullard *et al.* (2000) have proposed a stock structure that is related to sea-surface temperature: 1) a cold-water population west of the Labrador/North Atlantic current, and 2) a warm-water population that extends across the Atlantic in the Gulf Stream.

In U.S. Atlantic waters, pilot whales (*Globicephala* sp.) are distributed principally along the continental shelf edge off the northeastern U.S. coast in winter and early spring (CETAP 1982; Payne and Heinemann 1993; Abend and Smith 1999; Hamazaki 2002). In late spring, pilot whales move onto Georges Bank and into the Gulf of Maine and more northern waters, and remain in these areas through late autumn (CETAP 1982; Payne and Heinemann 1993). Pilot whales tend to occupy areas of high relief or submerged banks. They are also associated with the Gulf Stream wall and thermal fronts along the continental shelf edge (Waring *et al.* 1992; NMFS unpublished data). Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between Cape Hatteras, North Carolina, and New Jersey (Payne and Heinemann 1993;Garrison *et al.* in ~~review~~prep.).

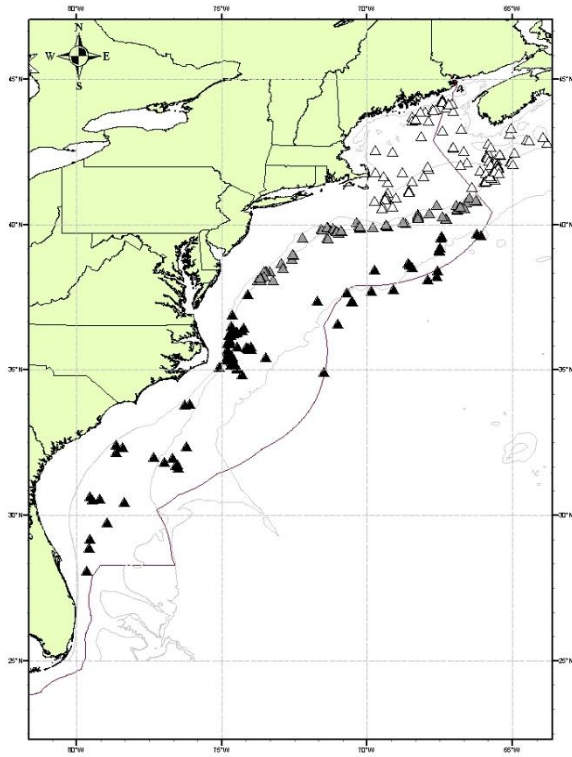

Figure 1. *Distribution of long-finned (open symbols), short-finned (black symbols), and possible mixed (gray symbols) pilot whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. The inferred distribution of the two species is preliminary and is valid for June-August only. Isobaths are at the 100-m, 1,000-m, and 4,000-m depth contours.*

POPULATION SIZE

The total number of long-finned pilot whales off the eastern U.S. and Canadian Atlantic coast is unknown, although several abundance estimates are available from selected regions for select time periods. Because long-finned and short-finned pilot whales are difficult to distinguish at sea, sighting data are reported as *Globicephala* sp. Sightings from vessel and aerial surveys were strongly concentrated along the continental shelf break; however, pilot whales were also observed over the continental slope in waters associated with the Gulf Stream (Figure 1). Combined abundance estimates for the 2 species have previously been derived from line-transect surveys. The best available abundance estimates are from surveys conducted during the summer of 2004. These survey data have been combined with an analysis of the spatial distribution of the 2 species based on genetic analyses of biopsy samples to derive separate abundance estimates (Garrison *et al.*, in prep.). The resulting abundance estimate for long-finned pilot whales in U.S. waters is 12,619 (CV=0.37).

Earlier estimates

Please see appendix IV for earlier estimates and descriptions of abundance surveys. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), if estimates are older than 8 years ~~are deemed unreliable and should not be used for~~ PBR is ~~determinations~~undetermined. Further, due to changes in survey methodology, the earlier data should not be used to make comparisons with more current estimates.

Recent surveys and abundance estimates for *Globicephala* sp.

An abundance estimate of 5,408 (CV=0.56) *Globicephala* sp. was obtained from an aerial survey conducted in July and August 2002 ~~which~~ that covered 7,465 km of trackline over waters from the 1000-m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)*, the probability of detecting a group on the track line, used for this estimation was derived from the pooled data of the 2002, 2004 and 2006 aerial surveys.

An abundance estimate of 15,728 (CV=0.34) *Globicephala* sp. was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Table 1; Palka 2006). Shipboard data were collected using the two-independent-team line-transect method and analyzed using the modified ~~direct~~ direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths >50 m) between Florida and Maryland (27.5ºN and 38ºN latitude) was conducted during June-August 2004. The survey employed 2 independent visual teams searching with 25× bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and collected a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina, along the shelf break. Data were corrected for visibility bias *g(0)* and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for *Globicephala* sp. between Florida and Maryland was 21,056 animals (CV=0.54; Garrison *et al.*~~,~~ in ~~review~~press).

An abundance estimate of 26,535 (CV=0.35) *Globicephala* sp. was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka pers. comm.).

An abundance estimate of 6,134 (95% CI=2,774-10,573) pilot whales was generated from the Canadian Trans-North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered the area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009).

Table 1. Summary of abundance estimates for the western North Atlantic *Globicephala* sp. by month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	5,408	0.56
Jun-Aug 2004	Maryland to the Bay of Fundy	15,728	0.34
Jun-Aug 2004	Florida to Maryland	21,056	0.54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	36,784	0.34
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	26,535	0.35
July-Aug 2007	N. Labrador to Scotian Shelf	6,134	0.28

Spatial Distribution and Abundance Estimates for *Globicephala melas*

Biopsy samples from pilot whales were collected during summer months (June-August) from South Carolina to the southern flank of Georges Bank between 1998 and 2007. These samples were identified to species using genetic analysis of mitochondrial DNA sequences. A portion of the mtDNA genome was sequenced from each biopsy sample collected in the field, and genetic species identification was performed through phylogenetic reconstruction of the haplotypes. Stranded specimens that were morphologically identified to species were used to assign clades in the phylogeny to species and thereby identify all samples (Garrison *et al.*, in prep). Based upon the date and location of sample collection, the probability of a sample being from a long-finned (or short-finned) pilot whale was evaluated as a function of sea-surface temperature and water depth using logistic regression. This analysis indicated that ~~at water temperatures < 22°C,~~ the probability of a sample coming from a long-finned pilot whale was near 1 at water temperatures < 22°C, and ~~at temperatures >25°C, this probability was~~ near 0 at temperatures >25°C. The probability of a long-finned pilot whale also decreased with increasing water depth. Spatially, during summer months, this habitat model predicts that all pilot whales observed in offshore waters near the Gulf Stream are most likely short-finned pilot whales. The area of overlap between the 2 species occurred primarily along the shelf break off the coast of New Jersey between 38°N and 40°N latitude. This habitat model was used to partition the abundance estimates from surveys conducted during the summer of 2004. The survey covering waters from Florida to Maryland was predicted to consist entirely of short-finned pilot whales. The aerial portion of the northeast survey covering the Gulf of Maine and the Bay of Fundy and surveys conducted in Canadian waters were predicted to consist entirely of long-finned pilot whales. The vessel portion of the northeast survey contained a mix of both species, with the sightings in offshore waters near the Gulf Stream predicted to consist of short-finned pilot whales. The best abundance estimate for long-finned pilot whales is thus the sum of the northeast aerial survey estimate (11,038 [CV=0.40], Palka 2006) and the estimated number of long-finned pilot whales from the ~~northeast~~ southeast vessel survey (1,581 [CV=0.86]). The best available abundance estimate is thus 12,619 (CV=0.37) (Palka 2006; Garrison *et al.*, in prep; Garrison *et al.*, in ~~review~~press).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for western North Atlantic long-finned pilot whales is 12,619 animals (CV=0.37). This reflects only the portion of the long-finned pilot whale population occupying U.S. waters. This is consistent with guidelines for assessment of trans-boundary stocks since the available mortality estimates are also restricted to U.S. waters. The minimum population estimate for long-finned pilot whales is 9,333.

Current Population Trend

There are insufficient data to determine population trends for *Globicephala melas melas.*

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity obtained from animals taken in the Newfoundland drive fishery include: calving interval 3.3 years; lactation period about 21-22 months; gestation period 12 months; births mainly from June to November; length at birth of 177 cm; mean length at sexual maturity of 490 cm for males and 356 cm for females; age at sexual maturity of 12 years for males and 6 years for females; mean adult length of 557cm for males and 448 cm for females; and maximum age of 40 for males and 50 for females (Sergeant 1962; Kasuya *et al.* 1988). Analysis of data from animals taken in the Faroe Islands drive fishery produced higher values for all parameters (Bloch *et al.* 1993; Desportes *et al.* 1993; Martin and Rothery 1993). These differences are likely related, at least in part, to larger sample sizes and different analytical techniques.

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for long-finned pilot whales is 9,333. The maximum productivity rate is 0.04, the default value for cetaceans. The “recovery” factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic long-finned pilot whale is 93.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human caused mortality of long-finned pilot whales cannot be determined. The highest bycatch rates in the pelagic longline fishery area were observed during September – October along the mid-Atlantic coast (Garrison 2007). In bottom trawls, most mortalities were observed in the same area between July and November (Rossman 2009). The model used to derive abundance estimates uses data restricted to the warmest months of the year (June-August), and there ~~is~~ are currently very ~~little~~ few data available for the potential area of overlap during the fall. Therefore, it is not possible to partition mortality estimates between the 2 species because there are very few available genetic samples from the area of overlap and season where most mortality occurs. Mortality and serious injury estimates are thus presented only for the 2 species combined. Total annual estimated average fishery-related mortality or serious injury during ~~2004-2008~~2005-2009 was ~~176~~ 162 pilot whales (CV=0.15~~0.14~~; Table 2). Of this, it is most likely that the mortality due to the pelagic longline fishery, the Northeast midwater trawl fishery, and the Northeast groundfish fishery have the most direct impact on long-finned pilot whales.

Fishery Information

Detailed fishery information is reported in Appendix III. Total fishery-related mortality and serious injury cannot be estimated separately for the 2 species of pilot whales in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeastern coast of the U.S. A fishery observer program, which has collected fishery data and information on incidental bycatch of marine mammals, was established in 1977 with the implementation of the Fisheries Conservation and Management Act (FCMA).

During 1977-1991, observers in this program recorded 436 pilot whale mortalities in foreign-fishing activities (Waring *et al.* 1990; Waring 1995). A total of 391 pilot whales (90%) was taken in the mackerel fishery, and 41 (9%) occurred during *Loligo* and *Illex* squid-fishing operations. This total includes 48 documented takes by U.S. vessels involved in joint-venture fishing operations. Two animals were also caught in both the hake and tuna longline fisheries (Waring *et al.* 1990).

Between 1989 and 1998, 87 mortalities were observed in the large pelagic drift gillnet fishery. The annual fishery-related mortality (CV in parentheses) was 77 in 1989 (0.24), 132 in 1990 (0.24), 30 in 1991 (0.26), 33 in 1992 (0.16), 31 in 1993 (0.19), 20 in 1994 (0.06), 9.1 in 1995 (0), 11 in 1996 (0.17), no fishery in 1997 and 12 in 1998 (0). This fishery was permanently closed in 1999.

Five pilot whale (*Globicephala* sp.) mortalities were reported in the self-reported fisheries information for the Atlantic tuna pair trawl in 1993. In 1994 and 1995 observers reported 1 and 12 mortalities, respectively. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery in 1994 was 2.0 (CV=0.49) and 22 (CV=0.33) in 1995.

Two interactions with pilot whales in the Atlantic tuna purse seine fishery were observed in 1996. In 1 interaction, the net was pursed around 1 pilot whale, the rings were released and the animal escaped alive, condition unknown. This set occurred east of the Great South Channel and just north of the Cultivator Shoals region on Georges Bank. In a second interaction, 5 pilot whales were encircled in a set. The net was opened prior to pursing to let the whales swim free, apparently uninjured. This set occurred on the Cultivator Shoals region on Georges Bank. No trips were observed during 1997 through 1999. Four trips were observed in September 2001, with no marine mammals observed taken during these trips.

No pilot whales were taken in observed mid-Atlantic ~~Coastal~~ coastal ~~Gillnet~~ gillnet trips during 1993-1997. One pilot whale was observed taken in 1998, and none were observed taken during 1999-2003. Observed effort was scattered between New York and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality attributed to this fishery was 7 (CV=1.10) in 1998.

One pilot whale take was observed in the *Illex* squid portion of the ~~Southern~~ southern New England/mid-

Atlantic ~~Squid~~squid, ~~Mackerel~~mackerel, ~~Butterfish~~ butterfish ~~Trawl~~ trawl fisheries in 1996 and 1 in 1998. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 45 in 1996 (CV=1.27), 0 in 1997, 85 in 1998 (CV=0.65) and 0 in 1999. However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

One pilot whale take was observed in the *Loligo* squid portion of the ~~Southern~~ southern New England/mid-Atlantic ~~Squid~~squid, ~~Mackerel~~mackerel, ~~Butterfish~~ butterfish ~~Trawl~~ trawl fisheries in 1999. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 0 between 1996 and 1998, and 49 in 1999 (CV=0.97). However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery has been included as a component of the mid-Atlantic bottom trawl fishery.

There was 1 observed take in the ~~Southern~~ southern New England/mid-Atlantic ~~Bottom~~ bottom ~~Trawl~~ trawl fishery reported in 1999. The estimated fishery-related mortality for pilot whales attributable to this fishery was 0 in 1996-1998, and 228 (CV=1.03) in 1999. After 1999 this fishery has been included as a component of the mid-Atlantic bottom trawl fishery.

A U.S. joint venture (JV) mid-water (pelagic) trawl fishery was conducted on Georges Bank from August to December 2001. Eight pilot whales were incidentally captured in a single mid-water trawl during JV fishing operations. Three pilot whales were incidentally captured in a single mid-water trawl during foreign fishing operations (TALFF).

For more details on earlier fishery interactions see Waring *et al.* (2007).

Pelagic Longline

Most of the estimated marine mammal bycatch in the U.S. pelagic longline fishery was recorded in U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007; Fairfield and Garrison 2008). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and 2008, 154 pilot whales were released alive, including 83 that were considered seriously injured, and 5 mortalities were observed (Johnson *et al.* 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009~~,~~; Garrison and Stokes~~,~~ 2010). January-March bycatch was concentrated on the continental shelf edge northeast of Cape Hatteras. Bycatch was recorded in this area during April-June, and takes also occurred north of Hydrographer Canyon off the continental shelf in water over 1,000 fathoms (1830 m) deep during April-June. During the July-September period, takes occurred on the continental shelf edge east of Cape Charles, Virginia, and on Block Canyon slope in over 1,000 fathoms of water. October-December bycatch occurred between the 20- and 50-fathom (37- and 92-m) isobaths between Barnegat Bay and Cape Hatteras.

The estimated fishery-related mortality to pilot whales in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery was: 127 in 1992 (CV=1.00), 0 from 1993-1998, 93 in 1999 (CV=1.00), 24 in 2000 (CV=1.00), 20 (CV=1.00) in 2001, 2 (CV=1.00) in 2002, 0 in 2003-2005, 16 (CV=1.00) in 2006 and 0 in 2007. The estimated serious injuries were 40 (CV=0.71) in 1992, 19 (CV=1.00) in 1993, 232 (CV=0.53) in 1994, 345 (CV=0.51) in 1995 including 37 estimated short-finned pilot whales (CV=1.00), 0 from 1996 to 1998, 288 (CV=0.74) in 1999, 109 (CV=1.00) in 2000, 50 in 2001 (CV=0.58), 51 in 2002 (CV=0.48), 21 in 2003 (CV=0.78), 74 in 2004 (CV=0.42), 212 (CV=0.21) in 2005, 169 (CV=0.47) in 2006, 57 (CV=0.47) in 2007, ~~and~~ 98 (CV=0.42) in 2008~~.~~, and 17 (CV ~~=~~ = 0.70) in 2009. The average 'combined' annual mortality in ~~2004-2008~~2005-2009 was ~~122~~ 114 pilot whales (CV=~~0.19~~0.20) (Table 2).

An experimental fishery was conducted on 6 vessels operating in the Gulf of Mexico and off the U.S. ~~east~~ East ~~coast~~ Coast in 2005, with 100% observer coverage achieved~~ during this experimental fishery~~. During this experiment, different ~~hook~~ hook-baiting techniques with standardized gangion and float line lengths were used, and hook timers and time-depth recorders were attached to the gear. The fishing techniques and gear employed during this experimental fishery do not represent those used during "normal" fishing efforts, and are thus presented separately in Table 2. Three pilot whales were released alive during this experimental fishery, including 1 ~~which~~ that was seriously injured (Fairfield Walsh and Garrison 2006).

Mid-Atlantic Bottom Trawl

Two pilot whales were observed taken in the mid-Atlantic bottom trawl in 2000, 4 in 2005, 1 in 2006, 0 in 2007, ~~and~~ 0 in 2008, and 0 in 2009. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 47 (CV=0.32) in 2000, 39 (CV=0.31) in 2001, 38 (CV=0.36) in 2002, 31 (CV=0.31) in 2003, 35 (CV=0.33) in 2004, 31 (CV=0.31) in 2005, 37 (CV=0.34) in 2006, 36 (CV=0.38) in 2007, ~~and~~ 24 (CV=0.36) in 2008~~,~~, and 23 (CV = 0.35) in 2009. The ~~2004-2008~~2005-2009 average mortality attributed to the mid-Atlantic bottom trawl was ~~34~~ 30 animals (CV=~~0.13~~0.16) (Table 2).~~.~~

Northeast Bottom Trawl

Two pilot whales were observed taken in the Northeast bottom trawl in 2004, 4 in 2005, 1 in 2006, 4 in 2007, ~~and~~ 5 in 2008, and 3 in 2009. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 18 (CV=0.29) in 2000, 30 (CV=0.27) in 2001, 22 (CV=0.26) in 2002, 20 (CV=0.26) in 2003, 15 (CV=0.29) in 2004, 15 (CV=0.30) in 2005, 14 (CV=0.28) in 2006, 12 (CV=0.35) in 2007, ~~and~~ 10 (CV=0.34) in 2008, and 9 (CV = 0.35) in 2009. The ~~2004-2008~~2005-2009 average mortality attributed to the northeast bottom trawl was ~~15~~ 12 animals (CV=~~0.13~~0.14) (Table 2).~~.~~

Northeast Mid-Water Trawl (Including Pair Trawl)

In Sept 2004 a pilot whale was observed taken in the paired mid-water trawl fishery on the northern edge of Georges Bank (off Massachusetts) in a haul that was targeting (and primarily caught) herring. In April 2008, six pilot whale takes were observed in the single mid-water trawl fishery in hauls targeting mackerel and located on the southern edge of Georges Bank. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed takes per observed hours the gear was in the water) for each year, where the paired and single Northeast mid-water trawls were pooled and only hauls that targeted herring ~~and~~ or mackerel were used. The VTR herring and mackerel data were used to estimate the total effort (Palka, pers. comm.). Estimated annual fishery-related mortalities were: unknown in 2001-2002, 0 in 2003, ~~and~~ 5.6 (CV=0.92) in 2004, 0 in 2005 to 2007, ~~and~~ 16 (CV=0.61) in 2008~~,~~, and 0 in 2009 (Table 2; Palka pers. comm.). The average annual estimated mortality during ~~2004-2008~~2005-2009 was ~~4.3~~3 (CV=0.~~51~~61).

Mid-Atlantic Mid-Water Trawl Fishery (Including Pair Trawl)

In March 2007 a pilot whale was observed bycaught in the single mid-water fishery in a haul targeting herring that was south of Rhode Island. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed pilot whale takes per observed hours the gear was in the water) for each year, where the paired and single Mid-Atlantic mid-water trawls were pooled and only hauls that targeted herring ~~and~~ or mackerel were used. The VTR herring and mackerel data were used to estimate the total effort (Palka, pers. comm.). Estimated annual fishery-related mortalities were unknown in 2002, 0 in 2003 to 2006, 12.1 (CV=0.99) in 2007, ~~, and~~ 0 in 2008~~,~~, and 0 in 2009 (Table 2; Palka pers. comm.). The average annual estimated mortality during ~~2004-2008~~2005-2009 was 2.4 (CV=0.99).

CANADA

~~An unknown~~ Unknown numbers of long-finned pilot whales have also been taken in Newfoundland, Labrador, and Bay of Fundy groundfish gillnets; Atlantic Canada and Greenland salmon gillnets; and Atlantic Canada cod traps (Read 1994).

Between January 1993 and December 1994, 36 Spanish deep-water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets), were observed in NAFO Fishing Area 3 (off the Grand Banks) (Lens 1997). A total of 47 incidental catches ~~were~~ was recorded, which included 1 long-finned pilot whale. The incidental mortality rate for pilot whales was 0.007/set.

In Canada, the fisheries observer program places observers on all foreign fishing vessels, on between 25% and 40% of large Canadian vessels (greater than 100 ft), and on approximately 5% of small vessels (Hooker *et al.* 1997). Fishery observer effort off the coast of Nova Scotia during 1991-1996 varied on a seasonal and annual basis, reflecting changes in fishing effort (see Figure 3, Hooker *et al.* 1997). During the 1991-1996 period, long-finned pilot whales were bycaught (number of animals in parentheses) in bottom trawl (65); midwater trawl (6); and longline (1) gear. Recorded bycatches by year were: 16 in 1991, 21 in 1992, 14 in 1993, 3 in 1994, 9 in 1995 and 6 in 1996. Pilot whale bycatches occurred in all months except January-March and September (Hooker *et al.* 1997).

There was 1 record of incidental catch in the offshore Greenland halibut fishery that involved 1 long-finned pilot whale in 2001; no expanded bycatch estimate was calculated (Benjamins *et al.* 2007).

Table 2. Summary of the incidental mortality and serious injury of pilot whales (*Globicephala* sp.) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Data Type[a]	Observer Coverage[b]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Bottom Trawl[c]	04-0805-09	Obs. Data Dealer	.03, .03, .02, .03, .03, .05	0, 0, 0, 0, 0, 0	0, 4, 1, 0, 0, 0	0, 0, 0, 0, 0, 0	35, 31, 37, 36, 24, 23	35, 31, 37, 36, 24, 23	.33, .31, .34, .38, .36, .36	30 (.16)33 (.13)
Northeast Bottom Trawl[c]	05-0904-08	Obs. Data Dealer Data VTR Data	.05, .12, .06, .06, .08., .05	0, 0, 0, 0, 0	0, 2, 4, 1, 4, 5, 3	0, 0, 0, 0, 0, 0	15, 15, 14, 12, 10, 9	15, 15, 14, 12, 10, 9	.29, .30, .28, .35, .34, .35	12 (.14)13 (.12)
Mid-Altlantic Mid-Water Trawl - Including Pair Trawl[d]	05-0904-08	Obs. Data Dealer Data VTR Data	.06, .08, .09, .04, .13, .13	0, 0, 0, 0, 0	0, 0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 12, 0, 0	0, 0, 0, 12, 0, 0	.0, 0, 0, 0.99, 0, 0	2.4 (0.99)
Northeast Mid-Water Trawl - Including Pair Trawl[d]	05-0904-08	Obs. Data Dealer Data VTR Data	.13, .20, .03, .08, .20, .42	0, 0, 0, 0, 0	1, 0, 0, 0, 6, 0	0, 0, 0, 0, 0, 0	5.3, 0, 0, 0, 16, 0	5.3, 0, 0, 0, 16, 0	0.92, 0, 0, 0, .61, 0	3 (.61)4.3 (.51)
Pelagic Longline	05-0904-08	Obs. Data Logbook	.09, .06, .07, .07, .07, .10	6, 9, 12, 5, 5, 2	0, 0, 1, 0, 0, 0	74, 212, 169, 57, 98, 17	0, 0, 16, 0, 0, 0	74, 212, 185, 57, 98, 17	.42, .21, .47, .65, .42, .70	122114 (.19.20)
2005 Pelagic Longline experimental fishery[e]	05	Obs. Data	1	1	0	1	0	1	1.000	1(1.000)
TOTAL										162 (.15)176 (.14)

[a] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).

[b] Observer coverage of the mid-Atlantic coastal gillnet fishery is a ratio based on tons of fish landed. Observer coverage for the longline fishery is a ratio based on sets. The trawl fisheries are ratios based on trips.

[c] NE and MA bottom trawl mortality estimates reported for 2007 to and 20098 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2007 and 20082007 to 2009 effort. Complete documentation of methods used to estimate cetacean bycatch mortality are described in Rossman (20092010).

[d] Within each of the fisheries (Northeast and Mid-Atlantic), the paired and single trawl data were pooled. Ratio estimation methods were used within each fishery and year to estimate the total the annual bycatch.

[e] A cooperative research program conducted during quarters 2 and 3 in 2005 (Fairfield Walsh and Garrison 2006).

Other Mortality

Pilot whales have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. Between 2 and 168 pilot whales have stranded annually, either individually or in groups, along the eastern U.S. seaboard since 1980 (NMFS 1993, stranding databases maintained by NMFS NER, NEFSC and SEFSC). From 2004 to 2008, 44 short-finned pilot whales (*Globicephala macrorhynchus*), 68 long-finned pilot whales (*Globicephala melas melas*), and 11 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Maine and Florida, including Puerto Rico and the Exclusive Economic Zone (EEZ) (Table 3). This includes 1 mass stranding of 18 long-finned pilot whales (including 1 pregnant female) as part of a multi-species mass stranding in Barnstable County, Massachusetts, on 10 December 2005 ~~.~~(Fehring and Wells 1976; Irvine *et al.* 1979; Odell *et al.* 1980).

A Virginia Coastal Small Cetacean Unusual Mortality Event (UME) occurred along the coast of Virginia from 1 May to 31 July 2004, when 66 small cetaceans stranded mostly along the outer (eastern) coast of Virginia's barrier islands, including 1 pilot whale (*Globicephala* sp.). Human interactions were implicated in 17 of the strandings (1 common and 16 bottlenose dolphins), other potential causes were implicated in 14 strandings (1 Atlantic white-sided dolphin, 2 harbor porpoises and 11 bottlenose dolphins), and no cause could be determined for the remaining strandings, including the pilot whale.

An Offshore Small Cetacean UME, was declared when 33 small cetaceans stranded from Maryland to Georgia between July and September 2004. The species involved are generally found offshore and are not expected to strand along the coast. One short-finned pilot whale was involved in this UME.

A UME mass stranding of 33 short-finned pilot whales, including 5 pregnant females, near Cape Hatteras, North Carolina, occurred from 15-16 January 2005. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn *et al.* 2006), but no single cause for the UME was determined.

Short-finned pilot whales strandings have been reported stranded as far north as Nova Scotia (1990) and Block Island, Rhode Island (2001), though the majority of the strandings occurred from North Carolina southward (Table 3). Long-finned pilot whales have been reported stranded as far south as Florida, ~~when~~ where 2 long-finned pilot whales were reported stranded in Florida in November 1998, though their flukes had been apparently cut off, so it is unclear where these animals actually may have died. One additional long-finned pilot whale stranded in South Carolina in 2003, though the confidence in the species identification was only moderate. This animal has subsequently been sequenced and mitochondrial DNA analysis supports the long-finned pilot whale identification. Most of the remaining long-finned pilot whale strandings were from North Carolina northward (Table 3).

During ~~2004-2008~~2005-2009, several human and/or fishery interactions were documented in stranded pilot whales. During a UME in Dare, North Carolina, in January 2005, 6 of the 33 short-finned pilot whales which mass stranded had fishery interaction marks (specifics not given) ~~which~~ that were healed and determined not to be the cause of death. A short-finned pilot whale stranded in May 2005 in North Carolina had net marks around the leading edge of the dorsal fin from the top to bottom, and had net marks on both fluke lobes. Two long-finned pilot whales stranded in Virginia in April 2005, 1 with a line on its flukes and another with human interactions noted but specifics not given. Of the 2006 stranding mortalities, 2 were reported as exhibiting signs of human interaction, 1 in Massachusetts and 1 in Virginia. In 2008, 1 Massachusetts stranding mortality was deemed a fishery interaction due to line markings and cut flukes. The 2 New York strandings of long-finned pilot whales were classified as human interactions. One long-finned pilot whale that stranded in Massachusetts in 2009 was classified as a human interaction because it had a piece of monofilament line in its stomach.

Table 3. Pilot whale (*Globicephala macrorhynchus* [SF], *Globicephala melas melas* [LF] *and Globicephala* sp. [Sp]) strandings along the Atlantic coast, 2005-2009. Strandings ~~which~~ that were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.

STATE	2005			2006			2007			2008			2009			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp
Nova Scotia[a]	0	0	2	0	0	3	0	0	2	0	0	0	0	0	15	0	0	22
Newfoundland and Labrador[b]	0	2	0	0	0	3	0	0	1	0	0	2	0	0	1	0	2	7
Maine[c]	0	2	0	0	1	0	0	1	0	0	1	1	0	3	0	0	8	1
New Hampshire	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Massachusetts[d]	0	22	0	0	2	0	0	6	0	0	1	1	0	4	0	0	35	1

Rhode Island	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	4	0
New York	0	1	0	0	0	0	0	2	0	0	2	0	0	1	0	0	6	0
New Jersey	0	0	2	1	0	0	0	1	0	0	1	0	1	1	0	2	3	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Maryland	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Virginia[e]	0	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	6	0
North Carolina[f]	35	1	2	0	0	1	0	0	0	3	0	1	2	0	0	40	1	4
South Carolina	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Florida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEZ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
TOTALS - U.S., Puerto Rico, & EEZ	35	35	4	1	6	1	0	10	0	3	7	4	4	11	0	43	69	9

[a] Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).

[b] (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009; 2010).

[c] Long-finned pilot whale stranded in Maine in 2007 released alive.

[d] Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December 2005. One of the strandings in 2007 classified as human interaction due to attempts to herd the animal to deeper water. -One of the 2009 animals was classified as a fishery interaction.

[e] One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated). Sign of human interaction (a line on the flukes) observed on 2 animals in 2005, and 1 animal was a pregnant female.

[f] In 2004, 1 short-finned pilot whale (September) and 1 pilot whale (November) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in February, not related to any UME. 2005 includes Unusual Mortality Event mass stranding of 33 short-finned pilot whales on 15-16 January, 2005, including 5 pregnant females. Six animals had fishery interaction marks, which were healed and not the cause of death. Signs of fishery interaction observed on a short-finned pilot whale stranded in May 2005.

In eastern Canada, 37 strandings of long-finned pilot whales (173 individuals) were reported on Sable Island, Nova Scotia, from 1970 to 1998 (Lucas and Hooker 2000). This included 130 animals that mass stranded in December 1976, and 2 smaller groups (<10 each) in autumn 1979 and summer 1992. Fourteen strandings were also recorded along Nova Scotia in 1991-1996 (Hooker *et al.* 1997). Several ~~mass~~ live mass-strandings occurred in Nova Scotia recently~~. F~~, including 14~~ourteen~~ ~~pilot whales live mass stranded~~ in 2000, 3 in 2001 in Judique, Inverness County, and 4 pilot whales live mass stranded at Point Tupper, Inverness County, in 2002, though no specification to species was made.

Mass strandings of long-finned pilot whales were more frequent several decades ago in Newfoundland when this species was more abundant (Table 4). Recent Newfoundland and Labrador strandings are reported in Table 3.

Table 4. Pilot whale mass strandings along the Newfoundland, Canada coast.

Year	Date	Number of Pilot Whales Stranded	Place in Newfoundland
1979	July 14	135	Pt. au Gaul
1980	October 19	70	Pt. Leamington
	October 25	18	Grand Beach
1982	July 27	23	Grand Bank
	August 18	3	Bonavista
1983	early January	10	Piccadilly
1984	July 15	5	Middle Cove
1990	December 14	4	St. Anthony

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery~~-~~ interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

A potential human-caused source of mortality is from polychlorinated biphenyls (PCBs) and chlorinated pesticides (DDT, DDE, dieldrin, etc.), moderate levels of which have been found in pilot whale blubber (Taruski *et al.* 1975; Muir *et al.* 1988; Weisbrod *et al.* 2000). Weisbrod *et al.* (2000) reported that bioaccumulation levels were more similar in whales from the same stranding group than animals of the same sex or age. Also, high levels of toxic metals (mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Island drive fishery (Nielsen *et al.* 2000). Similarly, Dam and Bloch (2000) found very high PCB levels in pilot whales in the Faroes. The population effect of the observed levels of such contaminants is unknown.

STATUS OF STOCK

The status of long-finned pilot whales relative to OSP in U.S. Atlantic EEZ is unknown. There are insufficient data to determine population trends for this species. The species is not listed under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for long-finned pilot whales is unknown, since it is not possible to partition mortality estimates between the ~~2 species~~long-finned and short-finned pilot whales. However, it is most likely not less than 10% of the calculated PBR and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The total fishery mortality may exceed PBR; however, it is unknown to what extent the pelagic longline fishery in particular impacts this stock. Due to the possibility of exceeding PBR, this should be considered a strategic stock. However, the inability to partition mortality estimates between the species limits the ability to adequately assess the status of this stock.

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SHORT-FINNED PILOT WHALE (*Globicephala macrorhynchus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are 2 species of pilot whales in the western North Atlantic - the long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea; therefore, the ability to separately assess the 2 stocks in U.S. Atlantic waters is limited. Sightings of pilot whales (*Globicephala sp.*) in the western North Atlantic occur primarily near the continental shelf break ranging from Florida to the Nova Scotian Shelf (Mullin and Fulling 2003). Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between Cape Hatteras, North Carolina, and New Jersey (Payne and Heinemann 1993; Garrison *et al.*, in ~~review~~prep.). In addition, short-finned pilot whales are documented along the continental shelf and continental slope in the northern Gulf of Mexico (Hansen *et al.* 1996; Mullin and Hoggard 2000; Mullin and Fulling 2003), and they are also known from the wider Caribbean. Studies are currently being conducted at the Southeast Fisheries Science Center to evaluate genetic population structure in short-finned pilot whales. Pending these results, the *Globicephala macrorhynchus* population occupying U.S. Atlantic waters is considered separate from both the northern Gulf of Mexico stock and short-finned pilot whales occupying Caribbean waters.

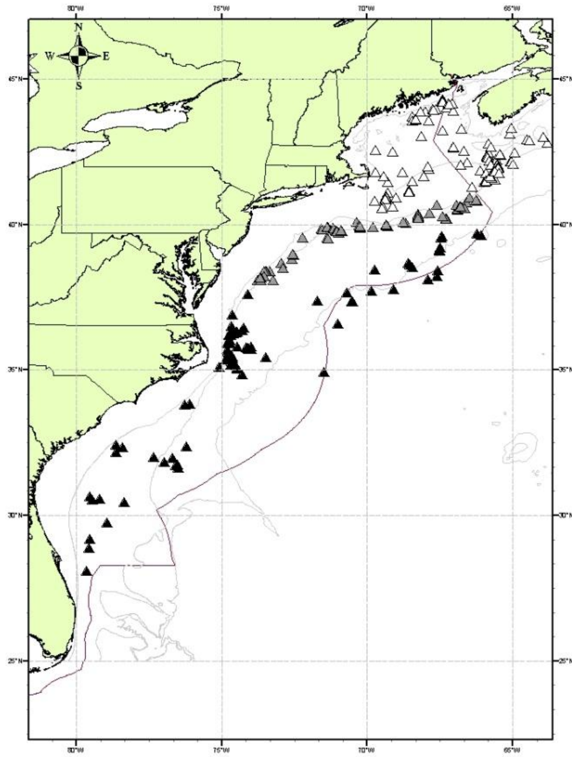

Figure 1. *Distribution of long-finned (open symbols), short-finned (black symbols), and possibly mixed (gray symbols) pilot whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. The inferred distribution of the two species is preliminary and is valid for June-August only. Isobaths are at the 100-m, 1,000-m, and 4,000-m depth contours.*

POPULATION SIZE

The total number of short-finned pilot whales off the eastern U.S. Atlantic coast is unknown, although several abundance estimates are available from selected regions for select time periods. Because long-finned and short-finned pilot whales are difficult to distinguish at sea, sightings data are reported as *Globicephala sp.* Sightings from vessel and aerial surveys were strongly concentrated along the continental shelf break; however, pilot whales were also observed over the continental slope in waters associated with the Gulf Stream (Figure 1). Combined abundance estimates for the 2 species have previously been derived from line transect surveys. The best available abundance estimates are from surveys conducted during the summer of 2004 because these are the most recent surveys covering the full range of pilot whales in U.S. Atlantic waters. These survey data have been combined with an analysis of the spatial distribution of the 2 species based on genetic analyses of biopsy samples to derive separate abundance estimates (Garrison *et al.*, in ~~review~~prep.). The resulting abundance estimate for short-finned pilot whales is 24,674 (CV=0.45).

Earlier Estimates

Please see appendix IV for earlier estimates and descriptions of abundance surveys. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), if estimates are older than 8 years ~~are deemed unreliable and~~

should not be used for PBR is determinationsundetermined. Further, due to changes in survey methodology, the earlier data should not be used to make comparisons with more current estimates.

Recent surveys and abundance estimates for *Globicephala* sp.

An abundance estimate of 5,408 (CV=0.56) *Globicephala* sp. was obtained from an aerial survey conducted in July and August 2002 covering 7,465 km of trackline in U.S. waters from the 1,000-m depth contour on the southern edge of Georges Bank north to the Gulf of Maine (Table 1; Palka 2006). The value of *g(0),* the probability of detecting a group on the track line, used for this estimation was derived from the pooled data of the 2002, 2004 and 2006 aerial surveys.

An abundance estimate of 15,728 (CV=0.34) *Globicephala* sp. was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Table 1; Palka 2006). Shipboard data were collected using the 2-independent-team line-transect method and analyzed using the modified direct direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0).* Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths >50 m) between Florida and Maryland (27.5°N and 38ºN latitude) was conducted during June-August 2004. The survey employed 2 independent visual teams searching with 25× bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and collected a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina, along the shelf break. Data were corrected for visibility bias *g(0)* and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for *Globicephala* sp. between Florida and Maryland was 21,056 animals (CV=0.54; Garrison *et al.*, in reviewpress).

An abundance estimate of 26,535 (CV=0.35) *Globicephala* sp. was obtained from an aerial survey conducted in August 2006 that covered 10,676 km of trackline in the region from the 2,000-m depth contour on the southern edge of Georges Bank north to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka pers. comm.).

An abundance estimate of 6,134 (95% CI=2,774-10,573) pilot whales was generated from the Canadian Trans North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered the area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009).

Table 1. Summary of abundance estimates for the western North Atlantic *Globicephala* sp. by month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	**Area**	N_{best}	**CV**
Aug 2002	S. Gulf of Maine to Maine	5,408	0.56
Jun-Aug 2004	Maryland to Bay of Fundy	15,728	0.34
Jun-Aug 2004	Florida to Maryland	21,056	0.54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	36,784	0.34
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	26,535	0.35
July-Aug 2007	N. Labrador to Scotian Shelf	6,134	0.28

Spatial Distribution and Abundance Estimates for *Globicephala macrorhynchus*

Biopsy samples from pilot whales were collected during summer months (June-August) from South Carolina to the southern flank of Georges Bank between 1998 and 2007. These samples were identified to species using genetic analysis of mitochondrial DNA sequences. A portion of the mtDNA genome was sequenced from each biopsy sample collected in the field, and genetic species identification was performed through phylogenetic reconstruction of the haplotypes. Stranded specimens that were morphologically identified to species were used to assign clades in the phylogeny to species and thereby identify all samples. Based upon the date and location of sample collection, the probability of a sample being from a short-finned (or long-finned) pilot whale was evaluated as a function of sea surface temperature and water depth using logistic regression. This analysis indicated that ~~at water temperatures < 22°C,~~ the probability of a sample coming from a short-finned pilot whales was near 0 at water temperatures < 22°C, and near 1 at temperatures >25°C~~, this probability was near 1~~. The probability of a short-finned pilot whale also increased with increasing water depth. Spatially, during summer months, this habitat model predicts that all pilot whales observed in offshore waters near the Gulf Stream are most likely short-finned pilot whales. The area of overlap between the 2 species occurred primarily along the shelf break off the coast of New Jersey between 38°N and 40°N latitude. This habitat model was used to partition the abundance estimates from surveys conducted during the summer of 2004. The survey covering waters from Florida to Maryland was predicted to consist entirely of short-finned pilot whales. The aerial portion of the northeast survey covering the Gulf of Maine and the Bay of Fundy and surveys conducted in Canadian waters were predicted to consist entirely of long-finned pilot whales. The vessel portion of the northeast survey contained a mix of both species, with the sightings in offshore waters near the Gulf Stream predicted to consist of short-finned pilot whales. The best abundance estimate for short-finned pilot whales is thus the sum of the southeast survey estimate (21,056 [CV=0.54]) and the estimated number of short-finned pilot whales from the northeast vessel survey (3,618 [CV=0.50]). The best available abundance estimate is thus 24,674 (CV=0.45) (Garrison *et al.*, in ~~review~~prep; Garrison *et al.*, in ~~prep.~~press).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for western North Atlantic *Globicephala macrorhnychus* is 24,674 animals (CV=0.45). The minimum population estimate is 17,190.

Current Population Trend

There are insufficient data to determine population trends for *Globicephala macrorhynchus.*

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity obtained from short-finned pilot whales taken in fisheries off the Pacific coast of Japan. In this region, there are 2 distinct stocks of short-finned pilot whales described as “northern” and “southern” types. There were demonstrable differences in the demographic parameters of these 2 forms perhaps related to habitat differences (Kasuya and Tai 1993). The northern form was generally larger and had a later age at sexual maturity than the southern form. The ranges of values for demographic parameters for both stocks are: calving interval 5.1 – 7.8 years; lactation period about 2.0 - 2.78 years; gestation period approximately 15 months; length at birth -140 ~~–~~– 185 cm; mean length at sexual maturity of 420 – 560 cm for males and 316-400 cm for females; mean age at sexual maturity of 17 years for males and 8 - 9 years for females; and maximum age of 45 for males and 62 for females (Kasuya and Tai 1993).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a “recovery” factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for short-finned pilot whales is 17,190. The maximum productivity rate is 0.04, the default value for cetaceans. The “recovery” factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic short-finned pilot whale is 172.

ANNUAL HUMAN-CAUSED MORTALITY

The total annual human caused mortality of short-finned pilot whales cannot be determined. The highest bycatch rates in the pelagic longline fishery area were observed during September – October along the mid-Atlantic coast (Garrison 2007). In bottom trawls, most mortalities were observed in the same area between July and

November (Rossman ~~2009~~2010). The model used to derive abundance estimates uses data restricted to the warmest months of the year (June-August), and there ~~is~~ are currently very ~~little~~ few data available for the potential area of overlap during the fall. Therefore it is not possible to partition mortality estimates between the 2 species because there are very few available genetic samples from the area of overlap and season where most mortality occurs. Mortality and serious injury estimates are thus presented only for the 2 species combined. Total annual estimated average fishery-related mortality or serious injury during 2005-2009 was 162 pilot whales (CV=0.15; Table 2). ~~Total annual estimated average fishery-related mortality or serious injury during 2004-2008 was 176 pilot whales (CV=0.14; Table 2).~~ Of this, it is most likely that the mortality due to the pelagic longline fishery, the mid-Atlantic midwater trawl fishery, and the mid-Atlantic groundfish fishery have the most direct impact on short-finned pilot whales.

Fishery Information

Detailed fishery information is reported in Appendix III. Total fishery-related mortality and serious injury cannot be estimated separately for the 2 species of pilot whales in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeastern coast of the U.S. A fishery observer program, which has collected fishery data and information on incidental bycatch of marine mammals, was established in 1977 with the implementation of the Fisheries Conservation and Management Act (FCMA).

During 1977-1991, observers in this program recorded 436 pilot whale mortalities in foreign-fishing activities (Waring *et al.* 1990; Waring 1995). A total of 391 pilot whales (90%) were taken in the mackerel fishery, and 41 (9%) occurred during *Loligo* and *Illex* squid-fishing operations. This total includes 48 documented takes by U.S. vessels involved in joint-venture fishing operations in which U.S. captains transfer their catches to foreign processing vessels. Two animals were also caught in both the hake and tuna longline fisheries (Waring *et al.* 1990).

Between 1989 and 1998, 87 mortalities were observed in the large pelagic drift gillnet fishery. The annual fishery-related mortality (CV in parentheses) was 77 in 1989 (0.24), 132 in 1990 (0.24), 30 in 1991 (0.26), 33 in 1992 (0.16), 31 in 1993 (0.19), 20 in 1994 (0.06), 9.1 in 1995 (0), 11 in 1996 (0.17), no fishery in 1997 and 12 in 1998 (0). This fishery was permanently closed in 1999.

Five pilot whale (*Globicephala* sp.) mortalities were reported in the self-reported fisheries information for the Atlantic tuna pair trawl in 1993. In 1994 and 1995 observers reported 1 and 12 mortalities, respectively. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery in 1994 was 2.0 (CV=0.49) and 22 (CV=0.33) in 1995.

Two interactions with pilot whales in the Atlantic tuna purse seine fishery were observed in 1996. In 1 interaction, the net was pursed around 1 pilot whale, the rings were released and the animal escaped alive, condition unknown. This set occurred east of the Great South Channel and just north of the Cultivator Shoals region on Georges Bank. In a second interaction, 5 pilot whales were encircled in a set. The net was opened prior to pursing to let the whales swim free, apparently uninjured. This set occurred on the Cultivator Shoals region on Georges Bank. No trips were observed during 1997 through 1999. Four trips were observed in September 2001 with no marine mammals observed taken during these trips.

No pilot whales were taken in observed mid-Atlantic ~~Coastal~~ coastal ~~Gillnet~~gillnet trips during 1993-1997. One pilot whale was observed taken in 1998, and none were observed taken from 1999-2003. Observed effort was scattered between New York and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality attributed to this fishery was 7 in 1998 (CV=1.10).

One pilot whale take was observed in the *Illex* squid portion of the ~~Southern~~ southern New England/mid-Atlantic ~~Squid~~squid, ~~Mackerel~~mackerel, ~~Butterfish~~ butterfish ~~Trawl~~ trawl fisheries in 1996 and 1 in 1998. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 45 in 1996 (CV=1.27), 0 in 1997, 85 in 1998 (CV=0.65) and 0 in 1999. However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

One pilot whale take was observed in the *Loligo* squid portion of the ~~Southern~~ southern New England/mid-Atlantic ~~Squid~~squid, ~~Mackerel~~mackerel, and ~~Butterfish~~ butterfish ~~Trawl~~ trawl fisheries in 1999. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 0 between 1996 and 1998 and 49 in 1999 (CV=0.97). These estimates should, however, be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery has been included as a component of the mid-Atlantic bottom trawl fishery.

There was 1 observed take in the ~~Southern~~ southern New England/mid-Atlantic ~~Bottom~~ bottom ~~Trawl~~ trawl fishery reported in 1999. The estimated fishery-related mortality for pilot whales attributable to this fishery was 0 from 1996-1998, and 228 (CV= 1.03) in 1999. After 1999 this fishery has been included as a component of the mid-Atlantic bottom fishery.

A U.S. joint venture (JV) mid-water (pelagic) trawl fishery was conducted on Georges Bank from August to December 2001. Eight pilot whales were incidentally captured in a single mid-water trawl during JV fishing operations. Three pilot whales were incidentally captured in a single mid-water trawl during foreign fishing operations (TALFF).

For more details on the earlier fishery interactions see Waring *et al.* (2007).

Pelagic Longline

Most of the estimated marine mammal bycatch in the U.S. ~~Pelagic~~ pelagic ~~Longline~~ longline ~~Fishery~~ fishery was recorded in U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007; Fairfield and Garrison 2008). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and 2008, 154 pilot whales were observed released alive, including 83 that were considered seriously injured, and 5 mortalities were observed (Johnson *et al.* 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007; Fairfield and Garrison 2008;~~,~~; Garrison et al. 2009, Garrison and Stokes, 2010~~Garrison *et al.* 2009~~). January-March bycatch was concentrated on the continental shelf edge northeast of Cape Hatteras. Bycatch was recorded in this area during April-June, and takes also occurred north of Hydrographer Canyon off the continental shelf in water over 1,000 fathoms (1830 m) deep during April-June. During the July-September period, takes occurred on the continental shelf edge east of Cape Charles, Virginia, and on Block Canyon slope in over 1,000 fathoms of water. October-December bycatch occurred between the 20- and 50-fathom (37- and 92-m) isobaths between Barnegat Bay and Cape Hatteras.

The estimated fishery-related mortality to pilot whales in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery was: 127 in 1992 (CV=1.00), 0 from 1993-1998, 93 in 1999 (CV=1.00), 24 in 2000 (CV=1.00), 20 (CV=1.00) in 2001, 2 (CV=1.00) in 2002, 0 in 2003-2005, 16 (CV=1.00) in 2006, and 0 in 2007. The estimated serious injuries were 40 (CV=0.71) in 1992, 19 (CV=1.00) in 1993, 232 (CV=0.53) in 1994, 345 (CV= 0.51) in 1995, (includes 37 estimated short-finned pilot whales in 1995 (CV=1.00), 0 from 1996 to 1998, 288 (CV=0.74) in 1999, 109 (CV=1.00) in 2000, 50 in 2001 (CV=0.58), 51 in 2002 (CV=0.48), 21 in 2003 (CV=0.78), 74 in 2004 (CV=0.42), 212 in 2005 (CV=0.21), 169 in 2006 (CV=0.31), 57 (CV=0.47) in 2007, 98 (CV=0.42) in 2008, and 17 (CV = 0.70) in 2009. The average 'combined' annual mortality in 2005-2009 was 114 pilot whales (CV=0.20) (Table 2). ~~, and 98 (CV=0.42) in 2008. The average 'combined' annual mortality and serious injury in 2004-2008 was 122 pilot whales (CV=0.19) (Table 2).~~

An experimental fishery was conducted on 6 vessels operating in the Gulf of Mexico and off the U.S. ~~east~~ East ~~coast~~ Coast in 2005, with 100% observer coverage achieved~~ during this experimental fishery~~. During this experiment, different ~~hook~~ hook-baiting techniques with standardized gangion and float line lengths were used, and hook timers and time-depth recorders were attached to the gear. The fishing techniques and gear employed during this experimental fishery do not represent those used during "normal" sighing efforts, and are thus presented separately in Table 2. Three pilot whales were released alive during this experimental fishery, including 1 ~~which~~ that was seriously injured (Fairfield Walsh and Garrison 2006).

Mid-Atlantic Bottom Trawl

Two pilot whales were observed taken in the mid-Atlantic bottom trawl in 2000, 4 in 2005, 1 in 2006, 0 in 2007, 0 in 2008, and 0 in2009~~, and 0 in 2008~~. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 47 (CV=0.32) in 2000, 39 (CV=0.31) in 2001, 38 (CV=0.36) in 2002, 31 (CV=0.31) in 2003, 35 (CV=0.33) in 2004, 31 (CV=0.31) in 2005, 37 (CV=0.34) in 2006, 37 (CV=0.38) in 2007, 24 (CV=0.36) in 2008, and 23 (CV = 0.35) in 2009. The 2005-2009 average mortality attributed to the mid-Atlantic bottom trawl was 30 animals (CV=0.16) (Table 2).~~, and 24 (CV=0.36) in 2008. The 2004-2008 average mortality attributed to the mid-Atlantic bottom trawl was 34 animals (CV=0.13).~~

Northeast Bottom Trawl

Two pilot whales were observed taken in the Northeast bottom trawl in 2004, 4 in 2005, 1 in 2006, 4 in 2007, 5 in 2008, and 3 in 2009. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 18 (CV=0.29) in 2000, 30 (CV=0.27) in 2001, 22 (CV=0.26) in 2002, 20 (CV=0.26) in 2003, 15 (CV=0.29) in 2004, 15 (CV=0.30) in 2005, 14 (CV=0.28) in 2006, 12 (CV=0.35) in 2007,10 (CV=0.34) in 2008, and 9 (CV = 0.35) in 2009. The 2005-2009 average mortality attributed to the northeast bottom trawl was 12 animals (CV=0.14) (Table 2).~~Two pilot whales were observed taken in the Northeast bottom trawl in 2004, 4 in 2005, 1 in 2006, 4 in 2007, and five in 2008. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 18 (CV=0.29) in 2000, 30 (CV=0.27) in 2001, 22 (CV=0.26) in 2002, 20 (CV=0.26) in 2003, 15 (CV=0.29) in 2004, 15 (CV=0.30) in 2005, 14 (CV=0.28) in 2006, 12 (CV=0.35) in 2007, and 10 (CV=0.34) in 2008. The 2004-2008 average mortality attributed to the northeast bottom trawl was 15 animals (CV=0.13).~~

Northeast Mid-Water Trawl – Including Pair Trawl

In Sept 2004 a pilot whale was observed taken in the paired mid-water trawl fishery on the northern edge of Georges Bank (off Massachusetts) in a haul that was targeting (and primarily caught) herring. In April 2008, six pilot whale takes were observed in the single mid-water trawl fishery in hauls targeting mackerel and located on the southern edge of Georges Bank. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed pilot whale takes per observed hours the gear was in the water) for each year, where the paired and single Northeast mid-water trawls were pooled and only hauls that targeted herring ~~and~~ or mackerel were used. The VTR herring and mackerel data were used to estimate the total effort (Palka, pers. comm.). Estimated annual fishery-related mortalities were: unknown in 2001-2002, 0 in 2003, and 5.6 (CV=0.92) in 2004, 0 in 2005 to 2007, 16 (CV=0.61) in 2008, and 0 in 2009 (Table 2; Palka pers. comm.). The average annual estimated mortality during 2005-2009 was 3 (CV=0.61).~~, and 16 (CV=0.61) in 2008 (Table 2; Palka pers. comm.). The average annual estimated mortality during 2004-2008 was 4.3 (CV=0.51).~~

Mid-Atlantic Mid-Water Trawl Fishery (Including Pair Trawl)

In March 2007 a pilot whale was observed bycaught in the single mid-water fishery in a haul targeting herring that was south of Rhode Island. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed pilot whale takes per observed hours the gear was in the water) for each year, where the paired and single Mid-Atlantic mid-water trawls were pooled only hauls that targeted herring ~~and~~ or mackerel were used. The VTR herring and mackerel data were used to estimate the total effort (Palka, pers. comm.). Estimated annual fishery-related mortalities were unknown in 2002, 0 in 2003 to 2006, 12.1 (CV=0.99) in 2007 0 in 2008, and 0 in 2009 (Table 2; Palka pers. com.). The average annual estimated mortality during 2005-2009 was 2.4 (CV=0.99).~~, and 0 in 2008 (Table 2; Palka pers. com.). The average annual estimated mortality during 2004-2008 was 2.4 (CV=0.99).~~

CANADA

~~An u~~Unknown numbers of long-finned pilot whales have also been taken in Newfoundland and Labrador, and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, and Atlantic Canada cod traps (Read 1994).

Between January 1993 and December 1994, 36 Spanish deep-water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets), were observed in NAFO Fishing Area 3 (off the Grand Banks) (Lens 1997). A total of 47 incidental catches ~~were~~ was recorded, which included 1 long-finned pilot whale. The incidental mortality rate for pilot whales was 0.007/set.

In Canada, the fisheries observer program places observers on all foreign fishing vessels, on between 25% and 40% of large Canadian vessels (greater than 100 ft), and on approximately 5% of small vessels (Hooker *et al.* 1997). Fishery observer effort off the coast of Nova Scotia during 1991-1996 varied on a seasonal and annual basis, reflecting changes in fishing effort (Hooker *et al.* 1997). During the 1991-1996 periods, long-finned pilot whales were bycaught (number of animals in parentheses) in bottom trawl (65); midwater trawl (6); and longline (1) gear. Recorded bycatches by year were: 16 in 1991, 21 in 1992, 14 in 1993, 3 in 1994, 9 in 1995 and 6 in 1996. Pilot whale bycatches occurred in all months except January-March and September (Hooker *et al.* 1997).

There was 1 record of incidental catch in the offshore Greenland halibut fishery that involved 1 long-finned pilot whale in 2001 although no expanded bycatch estimate was calculated (Benjamins *et al.* 2007).

Table 2. Summary of the incidental mortality and serious injury of pilot whales (*Globicephala* sp.) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Data Type[a]	Observer Coverage[b]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Bottom Trawl[c]	05-09~~04-08~~	Obs. Data Dealer	~~.03,~~ .03, .02, .03, .03, .05	~~0,~~ 0, 0, 0, 0, 0	~~0,~~ 4, 1, 0, 0, 0	~~0,~~ 0, 0, 0, 0	~~35,~~ 31, 37, 36, 24, 23	~~35,~~ 31, 37, 36, 24, 23	~~.33,~~ .31, .34, .38, .36, .36	30 (.16)~~33 (.13)~~
Northeast Bottom Trawl[c]	05-09~~04-08~~	Obs. Data Dealer Data VTR Data	~~.05,~~ .12, .06, .06, .08, .05	0, 0, 0, 0, 0	~~0,~~ 2, 4, 1, 4, 5, 3	~~0,~~ 0, 0, 0, 0	~~15,~~ 15, 14, 12, 10, 9	~~15,~~ 15, 14, 12, 10, 9	~~.29,~~ .30, .28, .35, .34, .36	12 (.14)~~13 (.12)~~
Mid-Altlantic Mid-Water Trawl - Including Pair Trawl[d]	05-09~~04-08~~	Obs. Data Dealer Data VTR Data	~~.06,~~ .08, .09, .04, .13, .13	0, 0, 0, 0, 0	~~0,~~ 0, 0, 1, 0, 0	~~0,~~ 0, 0, 0, 0	~~0,~~ 0, 0, 12, 0, 0	~~0,~~ 0, 0, 12 ,0, 0	~~.0,~~ 0, 0,0.99, 0, 0	2.4 (0.99)~~2.4 (0.99)~~
Northeast Mid-Water Trawl - Including Pair Trawl[d]	05-09~~04-08~~	Obs. Data Dealer Data VTR Data	~~.13,~~ .20, .03, .08, .20, .42	0, 0, 0, 0, 0	~~1,~~ 0, 0, 0, 6, 0	~~0,~~ 0, 0, 0, 0	~~5.3,~~ 0, 0, 0, 16, 0	~~5.3,~~ 0, 0, 0, 16, 0	~~0.92,~~ 0, 0, 0, .61, 0	3 (.61)~~4.3 (.51)~~
Pelagic Longline	05-09~~04-08~~	Obs. Data Logbook	~~.09,~~ .06, .07, .07, .07, .10	~~6,~~ 9, 12, 5, 5, 2	~~0,~~ 0, 1, 0, 0, 0	~~74,~~ 212, 169, 57, 98, 17	~~0,~~ 0, 16, 0, 0, 0	~~74,~~ 212, 185, 57, 98, 17	~~.42,~~ .21, .47, .65, .42, .70	114 (.20)~~122 (.19)~~
2005 Pelagic Longline experimental fishery[e]	05	Obs. Data	1	1	0	1	0	1	~~1.00~~0	1(0)~~1(1.00)~~
TOTAL										162 (.15)~~176 (.14)~~

[a] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).

[b] Observer coverage of the mid-Atlantic coastal gillnet fishery is a ratio based on tons of fish landed. Observer coverage for the longline fishery is a ratio based on sets. The trawl fisheries are ratios based on trips.

[c] NE and MA bottom trawl mortality estimates reported for 2007 ~~and~~ to ~~2008~~ 2009 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2007 to 2009 ~~2007 and 2008~~ effort. For complete documentation of methods used to estimate cetacean bycatch mortality see Rossman (~~2009~~2010).

[d] Within each of the fisheries (Northeast and Mid-Atlantic), the paired and single trawl data were pooled. Ratio estimation methods were used within each fishery and year to estimate the total the annual bycatch.

[e.] A cooperative research program conducted during quarters 2 and 3 in 2005 (Fairfield Walsh and Garrison 2006).

Other Mortality

Pilot whales have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. Between 2 and 168 pilot whales have stranded annually, either individually or in groups, along the eastern U.S. seaboard since 1980 (NMFS 1993, stranding databases maintained by NMFS NER, NEFSC and SEFSC). From 2004-2008, 44 short-finned pilot whales (*Globicephala macrorhynchus*), 68 long-finned pilot whales (*Globicephala melas melas*), and 11 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Maine and Florida, including Puerto Rico and the Exclusive Economic Zone (EEZ) (Table 3). This includes 1 mass stranding of 18 long-finned pilot whales (including 1 pregnant female) as part of a multi-species mass stranding in Barnstable County, Massachusetts, on 10 December 2005.

A Virginia Coastal Small Cetacean Unusual Mortality Event (UME) occurred along the coast of Virginia from 1 May to 31 July 2004, when 66 small cetaceans stranded mostly along the outer (eastern) coast of Virginia's barrier islands including 1 pilot whale (*Globicephala* sp.). Human interactions were implicated in 17 of the strandings (1 common and 16 bottlenose dolphins), other potential causes were implicated in 14 strandings (1 Atlantic white-sided dolphin, 2 harbor porpoises and 11 bottlenose dolphins), and no cause could be determined for the remaining strandings, including the pilot whale. A final report on this UME is pending (Barco, in prep.).

An Offshore Small Cetacean UME, was declared when 33 small cetaceans stranded from Maryland to Georgia between July and September 2004. The species involved are generally found offshore and are not expected to strand along the coast. One short-finned pilot whale was involved in this UME.

A UME mass stranding of 33 short-finned pilot whales, including 5 pregnant females, occurred near Cape Hatteras, North Carolina, from 15-16 January 2005. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn *et al.* 2006), but no single cause for the UME was determined.

Table 3. Pilot whale (*Globicephala macrorhynchus* [SF], *Globicephala melas melas* [LF] *and Globicephala* sp. [Sp]) strandings along the Atlantic coast, 2004-2008. Strandings ~~which~~ that were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.

STATE	2005			2006			2007			2008			2009			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp
Nova Scotia[a]	0	0	2	0	0	3	0	0	2	0	0	0	0	0	15	0	0	22
Newfoundland and Labrador[b]	0	2	0	0	0	3	0	0	1	0	0	2	0	0	1	0	2	7
Maine[c]	0	2	0	0	1	0	0	1	0	0	1	1	0	3	0	0	8	1
New Hampshire	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Massachusetts[d]	0	22	0	0	2	0	0	6	0	0	1	1	0	4	0	0	35	1
Rhode Island	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	4	0
New York	0	1	0	0	0	0	0	2	0	0	2	0	0	1	0	0	6	0
New Jersey	0	0	2	1	0	0	0	1	0	0	1	0	1	1	0	2	3	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Maryland	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Virginia[e]	0	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	6	0
North Carolina[f]	35	1	2	0	0	1	0	0	0	3	0	1	2	0	0	40	1	4
South Carolina	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Florida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEZ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
TOTALS - U.S., Puerto Rico, & EEZ	35	35	4	1	6	1	0	10	0	3	7	4	4	11	0	43	69	9

[a] Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).
[b] (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009).
[c] Long-finned pilot whale stranded in Maine in 2007 released alive.
[d] Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December 2005. One of the strandings in 2007 classified as human interaction due to attempts to herd the animal to deeper water. One of the 2009 animals was classified as a fishery interaction.
[e] One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified

to species (decomposed and decapitated). Sign of human interaction (a line on the flukes) observed on 2 animals in 2005, and 1 animal was a pregnant female.

[f] In 2004, 1 short-finned pilot whale (September) and 1 pilot whale (November) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in February, not related to any UME. 2005 includes Unusual Mortality Event mass stranding of 33 short-finned pilot whales on 15-16 January, 2005, including 5 pregnant females. Six animals had fishery interaction marks, which were healed and not the cause of death. Signs of fishery interaction observed on a short-finned pilot whale stranded in May 2005.

Short-finned pilot whales strandings (*Globicephala macrorhynchus*) have been reported as far north as Nova Scotia (1990) and Block Island, Rhode Island (2001), though the majority of the strandings occurred from North Carolina southward (Table 3). Long-finned pilot whales (*Globicephala melas*) have been reported stranded as far south as Florida, when 2 long-finned pilot whales were reported stranded in Florida in November 1998, though their flukes had been apparently cut off, so it is unclear where these animals actually may have died. One additional long-finned pilot whale stranded in South Carolina in 2003, though the confidence in the species identification was only moderate. This animal has subsequently been sequenced and mitochondrial DNA analysis supports the long-finned pilot whale identification. Most of the remaining long-finned pilot whale strandings were from North Carolina northward (Table 3). During ~~2004~~2005-~~2008~~2009, several human and/or fishery interactions were documented in stranded pilot whales. During a UME in Dare, North Carolina, in January 2005, 6 of the 33 short-finned pilot whales which mass stranded had fishery interaction marks (specifics not given) ~~which~~ that were healed and determined not to be the cause of death. A short-finned pilot whale stranded in May 2005 in North Carolina had net marks around the leading edge of the dorsal fin from the top to bottom, and had net marks on both fluke lobes. One long-finned pilot whale that stranded in Massachusetts in 2009 was classified as a human interaction because it had a piece of monofilament line in its stomach. ~~.~~ Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

A potential human-caused source of mortality is from polychlorinated biphenyls (PCBs) and chlorinated pesticides (DDT, DDE, dieldrin, etc.), moderate levels of which have been found in pilot whale blubber (Taruski *et al.* 1975; Muir *et al.* 1988; Weisbrod *et al.* 2000). Weisbrod *et al.* (2000) reported that bioaccumulation levels were more similar in whales from the same stranding group than animals of the same sex or age. Also, high levels of toxic metals (mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Island drive fishery (Nielsen *et al.* 2000). Similarly, Dam and Bloch (2000) found very high PCB levels in pilot whales in the Faroes. The population effect of the observed levels of such contaminants is unknown.

STATUS OF STOCK

The status of short-finned pilot whales relative to OSP in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine population trends for this species. The species is not listed under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for short-finned pilot whales is unknown, since it is not possible to partition mortality estimates between the ~~2 species~~long-finned and short-finned pilot whales. However, it is most likely not less than 10% of the calculated PBR and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The total fishery mortality ~~is unlikely to~~does not exceed PBR, ~~since~~ and some portion of the mortality impacts long-finned pilot whales. ~~, and therefore~~ Therefore, this is not a strategic stock. However, the inability to partition mortality estimates between the species limits the ability to adequately assess the status of this stock.

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ATLANTIC WHITE-SIDED DOLPHIN (*Lagenorhynchus acutus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

White-sided dolphins are found in temperate and sub-polar waters of the North Atlantic, primarily in continental shelf waters to the 100-m depth contour. In the western North Atlantic the species inhabits waters from central West Greenland to North Carolina (about 35˚N) and perhaps as far east as 29˚W in the vicinity of the mid-Atlantic Ridge (Evans 1987; Hamazaki 2002; Doksaeter *et al.* 2008; Waring *et al.* 2008). Distribution of sightings, strandings and incidental takes suggest the possible existence of three stock units: Gulf of Maine, Gulf of St. Lawrence and Labrador Sea stocks (Palka *et al.* 1997). Evidence for a separation between the population in the southern Gulf of Maine and the Gulf of St. Lawrence population comes from a virtual absence of summer sightings along the Atlantic side of Nova Scotia. This was reported in Gaskin (1992), is evident in Smithsonian stranding records, and was obvious during abundance surveys conducted in the summers of 1995 and 1999 which covered waters from Virginia to the Gulf of St. Lawrence and during the Canadian component of the TNASS survey in the summer of 2007 (Lawson and Gosselin 2009). White-sided dolphins were seen frequently in Gulf of Maine waters and in waters at the mouth of the Gulf of St. Lawrence, but only a few sightings were recorded between these two regions.

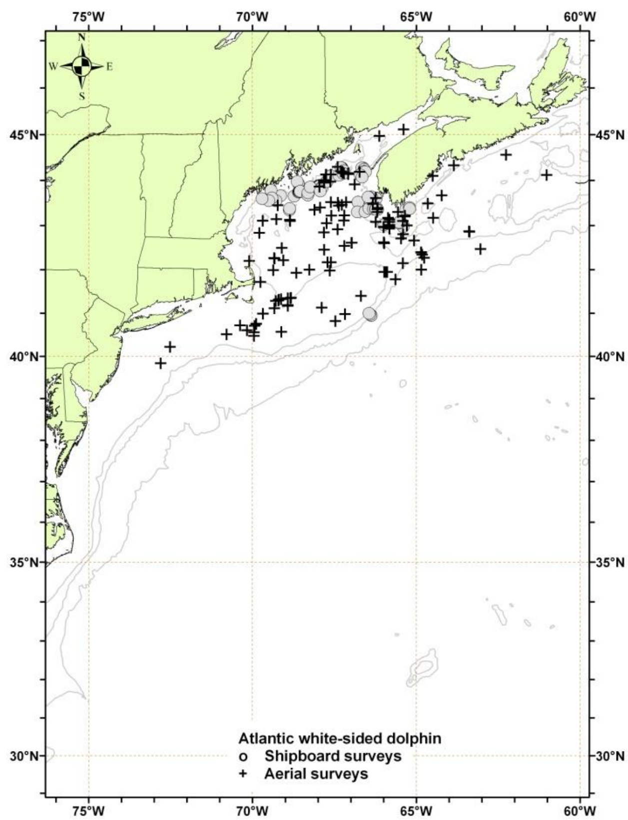

Figure 1. *Distribution of white-sided dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004,2006 and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

The Gulf of Maine population of white-sided dolphins is most common in continental shelf waters from Hudson Canyon (approximately 39˚N) on to Georges Bank, and in the Gulf of Maine and lower Bay of Fundy. Sightings data indicate seasonal shifts in distribution (Northridge *et al.* 1997). During January to May, low numbers of white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire), with even lower numbers south of Georges Bank, as documented by a few strandings collected on beaches of Virginia and North Carolina. From June through September, large numbers of white-sided dolphins are found from Georges Bank to the lower Bay of Fundy. From October to December, white-sided dolphins occur at intermediate densities from southern Georges Bank to southern Gulf of Maine (Payne and Heinemann 1990). Sightings south of Georges Bank, particularly around Hudson Canyon, occur year round but at low densities. The Virginia and North Carolina observations appear to represent the southern extent of the species' range during the winter months.

Recent stomach content analysis of both stranded and incidental caught white-sided dolphins in U.S. waters, determined that the most predominant prey were silver hake (*Merluccius bilinearis*), spoonarm octopus (*Bathypolypus bairdii*), and haddock (*Melanogrammus aeglefinus*).– Sand lances (*Ammodytes* spp.) were only found in the stomach of one stranded *L. acutus*. Seasonal variation in diet was indicated; pelagic Atlantic herring (*Clupea harengus*) was the most important prey in summer, but was rare in winter (Craddock *et al.* 2009).

POPULATION SIZE

The total number of white-sided dolphins along the eastern U.S. and Canadian Atlantic coast is unknown, although estimates from select regions are available from: spring, summer and autumn 1978-1982; July-September 1991-1992; June-July 1993; July-September 1995; July-August 1999; August 2002; June-July 2004; August 2006; and July-August 2007. The best available current abundance estimate for white-sided dolphins in the western North Atlantic stock is ~~63,368~~23,390 (CV=0.~~27~~23), ~~an average of the surveys conducted in August within the last 8 years (2002 and 2006). An average is used to account for the large inter-annual variability of the abundance estimates for this species. This variability may be associated with the water temperature and prey patterns~~the sum of the 2006 and 2007 surveys. While the combined estimate may include a certain amount of inter-annual redistribution, it is still felt to be the more representative than either estimate alone.

~~An abundance estimate of 109,141 (CV=0.30) white-sided dolphins was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000-m depth contour on the southern edge of Georges Bank to Maine (Table 1). The value of g(0) used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.~~

Earlier abundance estimates

Please see Appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), if estimates are older than eight years PBR is undetermined.

Recent surveys and abundance estimates

An abundance estimate of 2,330 (CV=0.80) white-sided dolphins was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the ~~100~~ 100-m depth contour on ~~the~~ southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed (Table 1). Shipboard data were collected using the two-independent-team line-transect method and analyzed using the modified direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the trackline. Aerial data were collected using the Hiby circle-back line- transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005). The value of aerial g(0) was derived from the pooled 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 17,594 (CV=0.30) white-sided dolphins was generated from an aerial survey conducted in August 2006 ~~which~~ that surveyed 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. Data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005). The value of g(0) was derived from the pooled 2002, 2004 and 2006 aerial survey data (Table 1; ~~Palka pers. comm~~NMFS 2006~~.~~).

An abundance estimate of 5,796 (95%CI=2,681-13,088) white-sided dolphins was generated from the Canadian Trans-North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009).

~~Please see Appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.~~

Table 1. Summary of recent abundance estimates for western North Atlantic stock of white-sided dolphins. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
~~Aug 2002~~	~~S. Gulf of Maine to Maine~~	~~109,141~~	~~0.30~~
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	2,330	0.80
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	17,594	0.30
Jul-Aug 2007	N. Labrador to Scotian Shelf	5,796	0.43

~~2002 and 2006~~2006 and 2007	~~Average of abundance estimates from 2 August surveys~~Sum of 2006 and 2007 surveys	~~63,368~~23, 390	~~0.27~~0.23

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by (Wade and Angliss 1997). The best estimate of abundance for the western North Atlantic stock of white-sided dolphins is 23,390 (CV=0.23)~~63,368 (CV=0.27)~~. The minimum population estimate for these white-sided dolphins is ~~50,883~~19,019.

Current Population Trend

A trend analysis has not been conducted for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: calving interval is 2-3 years; lactation period is 18 months; gestation period is 10-12 months and births occur from May to early August, mainly in June and July; length at birth is 110 cm; length at sexual maturity is 230-240 cm for males, and 201-222 cm for females; age at sexual maturity is 8-9 years for males and 6-8 years for females; mean adult length is 250 cm for males and 224 cm for females (Evans 1987); and maximum reported age for males is 22 years and for females, 27 years (Sergeant *et al.* 1980).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 19,019~~50,883~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic stock of white-sided dolphin is ~~509~~190.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during ~~2004~~2005-~~2008~~ 2009 was ~~266~~ 245 (CV=0.~~13~~12) white-sided dolphins (Table 2).

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

NMFS observers in the Atlantic foreign mackerel fishery reported 44 takes of Atlantic white-sided dolphins incidental to fishing activities in the continental shelf and continental slope waters between March 1977 and December 1991 (Waring *et al.* 1990; NMFS unpublished data). Of these animals, 96% were taken in the Atlantic mackerel fishery. This total includes 9 documented takes by U.S. vessels involved in joint-venture (JV) fishing operations in which U.S. captains transfer their catches to foreign processing vessels. No incidental takes of white-sided dolphins were observed in the Atlantic mackerel JV fishery when it was observed in 1998.

During 1991 to 1998, two white-sided dolphins were observed taken in the Atlantic pelagic drift gillnet fishery, both in 1993. Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 4.4 (.71) in 1989, 6.8 (.71) in 1990, 0.9 (.71) in 1991, 0.8 (.71) in 1992, 2.7 (0.17) in 1993 and 0 in 1994, 1995, 1996, and 1998. There was no fishery during 1997 and the fishery was permanently closed in 1999.

A U.S. JV mid-water (pelagic) trawl fishery was conducted during 2001 on Georges Bank from August to December. No white-sided dolphins were incidentally captured. Two white-sided dolphins were incidentally captured in a single mid-water trawl during foreign fishing operations (TALFF). During TALFF fishing operations all nets fished by the foreign vessel are observed. The total mortality attributed to the Atlantic herring JV and TALFF mid-water trawl fisheries in 2001 was two animals.

The mid-Atlantic gillnet fishery occurs year round from New York to North Carolina and has been observed since 1993. One white-sided dolphin was observed taken in this fishery during 1997. None were observed taken in other years. The estimated annual mortality (CV in parentheses) attributed to this fishery was 0 for 1993 to 1996, 45 (0.82) for 1997, 0 for 1998 to 2001, unknown in 2002 and 0 in 2003-~~2008~~2009.

U.S.

Northeast Sink Gillnet

~~This fishery occurs year round from in Gulf of Maine, Georges Bank and southern New England waters. Between 1990 and 2008 there were 64 white-sided dolphin mortalities observed in the Northeast sink gillnet fishery. Most were taken in waters south of Cape Ann during April to December. In recent years, the majority of the takes have been east and south of Cape Cod. During 2002, one of the takes was off Maine in the fall Mid-coast Closure Area in a pingered net.~~ Estimated annual ~~fishery-related~~ white-sided dolphin mortalities (CV in parentheses) attributed to the Northeast sink gillnet fishery were 49 (0.46) in 1991, 154 (0.35) in 1992, 205 (0.31) in 1993, 240 (0.51) in 1994, 80 (1.16) in 1995, 114 (0.61) in 1996 (Bisack 1997), 140 (0.61) in 1997, 34 (0.92) in 1998, 69 (0.70) in 1999, 26 (1.00) in 2000, 26 (1.00) in 2001, 30 (0.74) in 2002, 31 (0.93) in 2003, 7 (0.98) in 2004, 59 (0.49) in 2005, 41 (0.71) in 2006, 0 in 2007, ~~and~~ 81 (0.57) in 2008, and 0 in 2009. Average annual estimated fishery-related mortality during ~~2004~~2005-~~2008~~ 2009 was ~~38~~ 36 white-sided dolphins per year (0.~~33~~34; Table 2).

Northeast Bottom Trawl

~~Fifty-three~~White-sided dolphin mortalities ~~were~~ documented between 1991 and ~~2008~~ 2009 in the Northeast bottom trawl fishery~~;~~ were 1 during 1992, 0 in 1993, 2 in 1994, 0 in 1995-2001, 1 in 2002, 12 in 2003, 16 in 2004, 47 in 2005, 4 in 2006, 1 in 2007~~ and~~, 3 in 2008 and 31 in 2009. Estimated annual fishery-related mortalities (CV in parentheses) were 110 (0.97) in 1992, 0 in 1993, 182 (0.71) in 1994, 0 in 1995-1999, 137 (0.34) in 2000, 161 (0.34) in 2001, 70 (0.32) in 2002, 216 (0.27) in 2003, 200 (0.30) in 2004, 213 (0.28) in 2005, 164 (0.34) in 2006, 147 (0.35) in 2007, ~~and~~ 147 (0.32) in 2008, and 131 in 2009. The ~~2004~~2005-~~2008~~ 2009 average mortality attributed to the Northeast bottom trawl was ~~174~~ 160 animals (0.~~12~~14; Table 2).

Northeast Mid-water Trawl Fishery (Including Pair Trawl)

~~In July 2003 a white-sided dolphin was observed taken in the single trawl fishery on the northern edge of Georges Bank (off Massachusetts) in a haul that was targeting (and primarily caught) herring.~~ In September 2005 three white-sided dolphins were observed taken in paired trawls targeting herring that were located near Jefferys Bank (off Maine). Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed white-sided dolphin takes per observed hours the gear was in the water) for each year, where the paired and single Northeast mid-water trawls were pooled and only hauls that targeted herring and mackerel were used. The VTR herring and mackerel data were used to estimate the total effort in the bycatch estimate (Palka, pers. [bj1]comm.). Estimated annual fishery-related mortalities (CV in parentheses) were unknown in 2001-2002, 22 (0.97) in 2003, 0 in 2004, 9.4 (1.03) in 2005, and 0 in 2006 to ~~2008~~ 2009 (Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during ~~2004~~2005-~~2008~~ 2009 was 1.9 (1.03; Table 2).

Mid-Atlantic Mid-water Trawl Fishery (Including Pair Trawl)

~~In February 2004 a white-sided dolphin was observed taken in the pair trawl fishery near Hudson Canyon (off New Jersey) in a haul that was targeting mackerel.~~ In March 2005, five white-sided dolphins were observed taken in paired trawls targeting mackerel that were off Virginia. In February 2006, three animals were observed taken in mackerel paired mid-water trawls north of Hudson Canyon. In March 2007, an animal was observed taken in a mackerel single mid-water trawl near Hudson Canyon. In January and February 2008 three animals were observed in herring single mid-water trawls north of Hudson Canyon. In March 2009 an animal was observed in a pair trawl targeting mackerel south of Hudson Canyon. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed white-sided dolphin takes per observed hours the gear was in the water) for each year, where the paired and single Mid-Atlantic mid-water trawls were pooled and only hauls that targeted herring and mackerel were used. The VTR herring and mackerel data were used to estimate the total effort in the bycatch estimate (Palka, pers. comm.). Estimated annual fishery-related mortalities (CV in parentheses) were unknown in 2001-2002, 0 in 2003, 22 (0.99) in 2004, 58 (1.02) in 2005, 29 (0.74) in 2006, 12 (0.98) in 2007, ~~and~~ 15 (0.73) in 2008, and 4 (0.92) in 2009 (Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during ~~2004~~2005-~~2008~~ 2009 was ~~27~~ 24 (0.~~50~~55; Table 2).

Mid-Atlantic Bottom Trawl Fishery

One white-sided dolphin incidental take was observed in 1997, resulting in a mortality estimate of 161 (CV=1.58) animals. No takes were observed from 1998 through 2004 or in 2006 or 2008-2009;~~,~~ one take was observed in 2005 and 2 in 2007. Estimated annual fishery-related mortalities (CV in parentheses) were 27 (0.17) in 2000, 27 (0.19) in 2001, 25 (0.17) in 2002, 31 (0.25) in 2003, 26 (0.20) in 2004, 38 (0.29) in 2005, 26 (0.25) in 2006, 21 (0.24) in 2007, ~~and~~ 16 (0.18) in 2008, and 16 (0.16) in 2009. The ~~2004~~2005-~~2008~~ 2009 average mortality attributed to the mid-Atlantic bottom trawl was ~~25~~ 23 animals (0.~~10~~12; Table 2).

Table 2. Summary of the incidental mortality of white-sided dolphins (*Lagenorhynchus acutus*) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet[d]	~~04~~05-~~08~~09	Obs. Data Weighout Trip Logbook	~~.06,~~ .07, .04, .07, .05, .04	~~1,~~ 5, 2, 0, 4, 0	~~7,~~ 59, 41, 0, 81, 0	~~.98,~~ .49, .71, 0, .57, 0	~~38~~ 36 (0.~~33~~34)
Northeast Bottom Trawl[c]	~~04~~05-~~08~~09	Obs. Data Weighout	~~.05,~~ .12, .06, .06, .08, .09	~~16,~~ 47, 4, 1, 3, 31	~~200,~~ 213, 164, 147, 147, 131	~~.30,~~ .28, .34, .35, .32, .26	~~174~~ 160 (0.~~12~~14)
Northeast Mid-water Trawl - Including Pair Trawl	~~04~~05-~~08~~09	Obs. Data Weighout Trip Logbook	~~.126,~~ .199, .031, .08, .199, .42	~~0,~~ 3, 0, 0, 0, 0	~~0,~~ 0, 9.4, 0, 0, 0	~~.0,~~ 0, 1.03, 0, 0, 0	1.9 (1.03)
Mid-Atlantic Mid-water Trawl - Including Pair Trawl	~~04~~05-~~08~~09	Obs. Data Weighout Trip Logbook	~~.064,~~ .084, .089, .039, .133, .132	~~1,~~ 5, 3, 1, 3, 1	~~22,~~ 58, 29, 12, 15, 4	~~.99,~~ 1.02, .74, .98, .73, .92	~~27~~24 (0.~~50~~55)
Mid-Atlantic Bottom Trawl[c]	~~04~~05-~~08~~09	Obs. Data Weighout Trip Logbook	~~.03,~~ .03, .02, .03, .03, .05	~~0,~~ 1, 0, 2, 0, 0	~~26,~~ 38, 26, 21, 16, 16	~~.20,~~ .29, .25, .24, .18, .16	~~25~~ 23 (.~~10~~12)
Total							~~266~~ 245 (0.~~13~~12)

a Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Observer Program. NEFSC collects landings data (Weighout) that are used as a measure of total effort in the Northeast gillnet fishery. Mandatory Vessel Trip Report (VTR) (Trip Logbook) data are used to determine the spatial distribution of fishing effort in the sink gillnet fishery and in the two mid-water trawl fisheries. In addition, the Trip Logbooks are the primary source of the measure of total effort (soak duration) in the mid-water and bottom trawl fisheries.

b Observer coverages for the Northeast sink gillnet are ratios based on metric tons of fish landed. Observer coverages of the trawl fisheries are ratios based on trips.

c ~~A new method was used to develop preliminary estimates of mortality for the mid-Atlantic and Northeast trawl fisheries during 2003-2007. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates from 2003 and afterwards.~~ NE and MA bottom trawl mortality estimates reported for 2008 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2008 effort (Rossman 2010). NE and MA bottom trawl mortality estimates reported for 2009 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2009 effort (Rossman 2010).

d After 1998, a weighted bycatch rate was applied to effort from both pingered and non-pingered hauls within the stratum where white-sided dolphins were observed taken. During the years 1997, 1999, 2001, 2002, and 2004, respectively, there were 2, 1, 1, 1, and 1 observed white-sided dolphins taken on pingered trips. No takes were observed on pinger trips during 1995, 1996, 1998, 2000, 2005 through 2007. Three of the 2008 takes were on non-pingered hauls and the fourth take was recorded as pinger~~–~~ condition unknown.

CANADA

There is little information available that quantifies fishery interactions involving white-sided dolphins in Canadian waters. Two white-sided dolphins were reported caught in groundfish gillnet sets in the Bay of Fundy during 1985 to 1989, and 9 were reported taken in West Greenland between 1964 and 1966 in the now non-operational salmon drift nets (Gaskin 1992). Several (number not specified) were also taken during the 1960s in the now non-operational Newfoundland and Labrador groundfish gillnets. A few (number not specified) were taken in an experimental drift gillnet fishery for salmon off West Greenland which took place from 1965 to 1982 (Read 1994).

Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on 25-40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. Bycaught marine mammals were noted as weight in kilos rather than by the numbers of animals caught. Thus the number of individuals was estimated by dividing the total weight per species per trip by the maximum recorded weight of each species. During 1991 through 1996, an estimated 6 white-sided dolphins were observed taken. One animal was from a longline trip south of the Grand Banks (43º 10'N 53º 08'W) in November 1996 and the other 5 were taken in the bottom trawl fishery off Nova Scotia in the Atlantic Ocean; 1 in July 1991, 1 in April 1992, 1 in May 1992, 1 in April 1993, 1 in June 1993 and 0 in 1994 to 1996.

Estimation of small cetacean bycatch for Newfoundland fisheries using data collected during 2001 to 2003 (Benjamins *et al.* 2007) indicated that, while most of the estimated 862 to 2,228 animals caught were harbor porpoises, a few were white-sided dolphins caught in the Newfoundland nearshore gillnet fishery and offshore monkfish/skate gillnet fisheries.

Herring Weirs

During the last several years, one white-sided dolphin was released alive and unharmed from a herring weir in the Bay of Fundy (A. Westgate, pers. comm.). Due to the formation of a cooperative program between Canadian fishermen and biologists, it is expected that most dolphins and whales will be able to be released alive. Fishery information is available in Appendix III.

Other Mortality

U.S.

During ~~2004~~2005-~~2008~~ 2009 there were ~~264~~ 245 documented Atlantic white-sided dolphin strandings on the US Atlantic coast (Table 3). ~~Twenty-nine~~Forty of these animals were released alive. Human interaction was indicated in ~~ten~~ 14 records during this period. Of these, ~~two were~~one was classified as a fishery interaction~~s~~.

Mass strandings involving up to a hundred or more animals at one time are common for this species. The causes of these strandings are not known. Because such strandings have been known since antiquity, it could be presumed that recent strandings are a normal condition (Gaskin 1992). It is unknown whether human causes, such as fishery interactions and pollution, have increased the number of strandings. An Unusual Mortality Event (UME) was declared in 2008 due to a relatively high number of strandings between January and April 2008, from New Jersey to North Carolina. Five white-sided dolphins were involved in this event (http://www.nmfs.noaa.gov/pr/health/mmume/midatlantic2008.htm, accessed 19 April 2011). Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

CANADA

Small numbers of white-sided dolphins have been ~~taken~~ hunted off southwestern Greenland and they have been taken deliberately by shooting elsewhere in Canada (Reeves *et al.* 1999). The Nova Scotia Stranding Network documented whales and dolphins stranded on the coast of Nova Scotia during 1991 to 1996 (Hooker *et al.* 1997). Researchers with Dept. of Fisheries and Oceans (DFO), Canada documented strandings on the beaches of Sable Island during 1970 to 1998 (Lucas and Hooker 2000). Sable Island is approximately 170 km southeast of mainland Nova Scotia. White-sided dolphins stranded at nearly all times of the year on the mainland and on Sable Island. On the mainland of Nova Scotia, a total of 34 stranded white-sided dolphins was recorded between 1991 and 1996: 2 in 1991 (August and October), 26 in July 1992, 1 in Nov 1993, 2 in 1994 (February and November), 2 in 1995 (April and August) and 2 in 1996 (October and December). During July 1992, 26 white-sided dolphins stranded on the Atlantic side of Cape Breton. Of these, 11 were released alive and the rest were found dead. Among the rest of the Nova Scotia strandings, one was found in Minas Basin, two near Yarmouth and the rest near Halifax. On Sable Island, 10 stranded white-sided dolphins were documented between 1991 and 1998; all were males, 7 were young males (< 200 cm), 1 in January 1993, 5 in March 1993, 1 in August 1995, 1 in December 1996, 1 in April 1997 and 1 in February 1998.

Whales and dolphins stranded between 1997 and ~~2008~~ 2009 on the coast of Nova Scotia as recorded by the

Marine Animal Response Society (MARS) and the Nova Scotia Stranding Network are as follows (Table 3): 0 white-sided dolphins stranded in 1997 to 2000, 3 in September 2001 (released alive), 5 in November 2002 (4 were released alive), 0 in 2003, 19-24 in 2004 (15-20 in October (some (unspecified) were released alive) and 4 in November were released alive), 0 in 2005, and 1 in 2006, 8-10 in 2007 (all but 3 released alive), ~~and~~ 3 (one released alive) in 2008, and 4 (3 released alive) in 2009 (T. Wimmer, pers. comm.).

White-sided dolphins recorded by the Whale Release and Strandings Program in Newfoundland and Labrador are as follows: 1 animal (released alive) in 2004, 1 in 2005 (dead), 3 in 2006 (all dead), 1 in 2007 (released alive) ~~and~~ 2 in 2008 (one released alive and one dead), and 3 (all dead) in 2009 (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009;2010).

~~Table 3. White-sided dolphin (*Lagenorhynchus acutus*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2004-2008.~~

~~Area~~	~~-~~				~~-~~	~~**Total**~~
	~~2004~~	~~2005~~	~~2006~~	~~2007~~	~~2008~~	
~~Maine~~	~~10~~	~~3~~	~~3~~	~~1~~	~~1~~	~~18~~
~~New Hampshire~~	~~-~~	~~1~~	~~-~~	~~-~~	~~-~~	~~1~~
~~Massachusetts[a,b]~~	~~34~~	~~60~~	~~49~~	~~18~~	~~33~~	~~194~~
~~Rhode Island~~	~~-~~	~~2~~	~~4~~	~~-~~	~~-~~	~~6~~
~~Connecticut~~	~~-~~	~~-~~	~~-~~	~~-~~	~~1~~	~~1~~
~~New York[c]~~	~~1~~	~~-~~	~~3~~	~~5~~	~~1~~	~~10~~
~~New Jersey~~	~~1~~	~~6~~	~~1~~	~~-~~	~~-~~	~~8~~
~~Delaware~~	~~-~~	~~-~~	~~1~~	~~-~~	~~-~~	~~1~~
~~Maryland~~	~~-~~	~~1~~	~~1~~	~~-~~	~~1~~	~~3~~
~~Virginia[b]~~	~~4~~	~~3~~	~~3~~	~~-~~	~~1~~	~~11~~
~~North Carolina~~	~~2~~	~~3~~	~~1~~	~~1~~	~~3~~	~~10~~
~~South Carolina~~	~~-~~	~~-~~	~~-~~	~~-~~	~~1~~	~~1~~
~~**TOTAL US**~~	~~**52**~~	~~**79**~~	~~**66**~~	~~**25**~~	~~**42**~~	~~**264**~~
~~Nova Scotia~~	~~2~~	~~-~~	~~1~~	~~9~~	~~3~~	~~15~~
~~Newfoundland and Labrador~~	~~1~~	~~1~~	~~3~~	~~1~~	~~2~~	~~8~~
~~GRAND TOTAL~~	~~55~~	~~80~~	~~70~~	~~35~~	~~47~~	~~287~~

~~[a] Records of mass strandings in Massachusetts during this period are: February 2005 - 8 animals (3 released alive); April 2005 - 6 animals (all released alive); May 2005 strandings of 2 animals (both released alive but one died later); 3 animals (one released alive) and 5 animals; December 2005 - 2 animals; January 2006 - 4 separate events involving 23 white-sided dolphins (5 released alive); February 2006 - 2 events involving 1 and 5 animals; July 2006 - 9 animals (7 released alive); January 2007 - 9 animals (3 released alive); September 2007 - 3 animals; January 2008 -17animals, February 2008 3 animals (2 released alive).~~

~~[b] Strandings that appear to involve a human interaction are: 1 animal from Massachusetts in 2004 was a fishery interaction; and 1 other animal from Massachusetts in 2004 was found with twine obstructing its esophagus.~~

In 2005, 5 animals had signs of human interaction but in no case was the human interaction able to be determined to be the cause of death. In 2006, 1 animal from Massachusetts was classified as having signs of fishery interaction. In 2008 2 animals from Massachusetts and one from South Carolina were classified as human interactions.

[c] Records of mass strandings in New York during this period are: September 2007 - 3 animals.

Table 3. White-sided dolphin (*Lagenorhynchus acutus*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2005-2009.

Area	2005	2006	2007	2008	2009	**Total**
Maine	3	3	1	1	1	9
New Hampshire	1	-	-	-	1	2
Massachusetts[a,b]	60	49	18	33	22	182
Rhode Island	2	4	-	-	1	7
Connecticut	-	-	-	1	1	2
New York[c]	-	3	5	1	3	12
New Jersey	6	1	-	-	2	9
Delaware	-	1	-	-	1	2
Maryland	1	1	-	1	-	3
Virginia[b]	3	3	-	1	-	7
North Carolina	3	1	1	3	1	9
South Carolina	-	-	-	1	-	1
TOTAL US	**79**	**66**	**25**	**42**	33	245
Nova Scotia	-	1	9	3	4	17
Newfoundland and Labrador	1	3	1	2	3	10
GRAND TOTAL	80	70	35	47	40	272

[a] Records of mass strandings in Massachusetts during this period are: February 2005 - 8 animals (3 released alive); April 2005 - 6 animals (all released alive); May 2005 strandings of 2 animals (both released alive but one died later); 3 animals (one released alive) and 5 animals; December 2005 - 2 animals; January 2006 - 4 separate events involving 23 white-sided dolphins (5 released alive); February 2006 - 2 events involving 1 and 5 animals; July 2006 - 9 animals (7 released alive); January 2007 - 9 animals (3 released alive); September 2007 - 3 animals; January 2008 -17animals, February 2008 - 3 animals (2 released alive); September 2009 - 3 events of 2, 3 and 4 animals (all but 1 released alive); April 2009 - 3 animals (all released alive).

[b] In 2005, 5 animals had signs of human interaction but in no case was the human interaction able to be determined to be the cause of death. In 2006, 1 animal from Massachusetts was classified as having signs of fishery interaction. In 2008, 2 animals from Massachusetts and one from South Carolina were classified as human interactions. In 2009, the 4 animals that mass-stranded in September and were released alive, as well as a March stranding that a bystanded had attempted to rescue were classified at human interactions.

[c] Records of mass strandings in New York during this period are: September 2007 - 3 animals.

STATUS OF STOCK

The status of white-sided dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. A trend analysis has not been conducted for this species. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is a ~~non-~~strategic stock because the ~~2004~~2005-~~2008~~ 2009 estimated average annual human related mortality ~~does not~~ exceeds PBR.

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SHORT-BEAKED COMMON DOLPHIN (*Delphinus delphis delphis*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The common dolphin may be one of the most widely distributed species of cetaceans, as it is found world-wide in temperate and subtropical seas. In the North Atlantic, common dolphins occur over the continental shelf along the 100-2000-m isobaths and over prominent underwater topography and east as to the mid-Atlantic Ridge (29˚W) (Doksaeter *et al.* 2008; Waring *et al*. 2008). The species is less common south of Cape Hatteras, although schools have been reported as far south as the Georgia/South Carolina border (32º N) (Jefferson *et al*. 2009). In waters off the northeastern USA coast common dolphins are distributed along the continental slope and are associated with Gulf Stream features (CETAP 1982; Selzer and Payne 1988; Waring *et al.* 1992; Hamazaki 2002). They occur from Cape Hatteras northeast to Georges Bank (35˚ to 42˚N) during mid-January to May (Hain *et al.* 1981; CETAP 1982; Payne *et al.* 1984). Common dolphins move onto Georges Bank and the Scotian Shelf from mid-summer to autumn. Selzer and Payne (1988) reported very large aggregations (greater than 3,000 animals) on Georges Bank in autumn. Common dolphins are occasionally found in the Gulf of Maine (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11ºC (Sergeant *et al.* 1970; Gowans and Whitehead 1995).

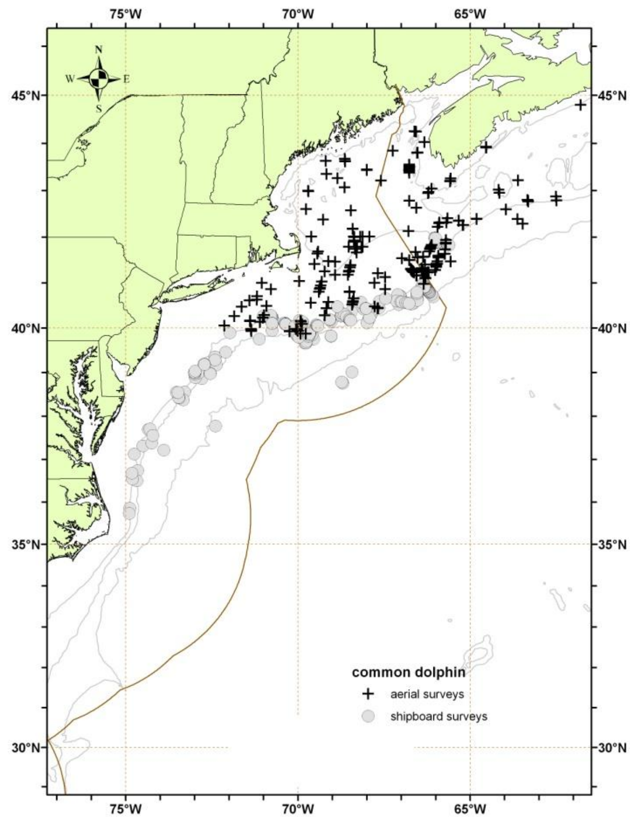

Figure 1. *Distribution of common dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

Westgate (2005) tested the proposed one-population-stock model using a molecular analysis of mitochondrial DNA (mtDNA), as well as a morphometric analysis of cranial specimens. Both genetic analysis and skull morphometrics failed to provide evidence ($p>0.05$) of more than a single population in the western North Atlantic, supporting the proposed one stock model. However, when western and eastern North Atlantic common dolphin mtDNA and skull morphology were compared, both the cranial and mtDNA results showed evidence of restricted gene flow ($p<0.05$) indicating that these two areas are not panmictic. Cranial specimens from the two sides of the North Atlantic differed primarily in elements associated with the rostrum. These results suggest that common dolphins in the western North Atlantic are composed of a single panmictic group whereas gene flow between the western and eastern North Atlantic is limited (Westgate 2005; 2007).

There is also a peak in parturition during July and August with an average birth day of 28 July ~~28th~~. Gestation lasts about 11.7 months and lactation lasts at least a year. Given these results western North Atlantic female common dolphins are likely on a 2-3 year calving interval. Females become sexually mature earlier (8.3 years and 200 cm) than males (9.5 years and 215 cm) as males continue to increase in size and mass. There is significant sexual dimorphism present with males being on average about 9% larger in body length (Westgate 2005; Westgate and Read 2007).

POPULATION SIZE

The total number of common dolphins off the U.S. or Canadian Atlantic coast is unknown, although several abundance estimates are available from selected regions for selected time periods. The best abundance estimate for common dolphins is 120,743 animals (CV=0.23). This is the sum of the estimates from two 2004 U.S. Atlantic surveys, where the estimate from the northern U.S. Atlantic is 90,547 (CV=0.24), and from the southern U.S. Atlantic is 30,196 (CV=0.54). This joint estimate is considered best because these two surveys have the most complete coverage of the species' habitat (Table 1).

~~An abundance estimate of 6,460 (CV=0.74) common dolphins was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1: Palka 2006). The value of g(0) used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.~~

An abundance estimate of 90,547 (CV=0.244) common dolphins was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of trackline in waters north of Maryland (38ºN) (Table 1; Palka 2006). Shipboard data were collected using the two-independent-team line-transect method and analyzed using the modified direct-duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the trackline. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

An abundance estimate of 30,196 (CV=0.537) common dolphins was derived from a shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths > 50 m) between Florida and Maryland (27.5 and 38º N latitude) conducted during June-August, 2004 (Table 1). The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias (*g(0)*) and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001; Palka 2006).

An abundance estimate of 84,000 (CV=0.36) common dolphins was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka pers. comm.).

An abundance estimate of 53,625 (95% CI=35,179-81,773) common dolphins was generated from the Canadian Trans North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009).

Please see appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), if estimates are older than eight years ~~are deemed unreliable and should not be used for~~ PBR is ~~determinations~~undetermined.

Table 1. Summary of abundance estimates for western North Atlantic short-beaked common dolphin. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
~~Aug 2002~~	~~S. Gulf of Maine to Maine~~	~~6,460~~	~~0.74~~
Jun-Aug 2004	Maryland to Bay of Fundy	90,547	0.24
Jun-Aug 2004	Florida to Maryland	30,196	0.54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	120,743	0.23
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	84,000	0.36
July-Aug 2007	N. Labrador to Scotian Shelf	53,625	0.22

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for common dolphins is 120,743 animals (CV=0.23) derived from the 2004 surveys. The minimum population estimate for the western North Atlantic common dolphin is 99,975.

Current Population Trend

A trend analysis has not been conducted for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 99,975 animals. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor is 0.5, the default value for stocks of unknown status relative to optimum sustainable population (OSP), and because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic stock of common dolphin is 1,000.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during ~~2004~~2005-~~2008~~ 2009 was ~~167~~ 164 (CV=0.~~11~~12) common dolphins. This is derived from two components: 164 (CV=0.12) from the observed fishery mortality and serious injury (Table 2), and 0.2 from the 2005-2009 average annual research activity mortalities and serious injuries that were not included in the bycatch estimates, rounded to the nearest integer. ~~(Table 2).~~

Fishery information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

For more details on the historical fishery interactions prior to 1999 see Waring *et al.* (2007).

In the Atlantic pelagic longline fishery between 1990 and 2007, 20 common dolphins were observed hooked and released alive.

The estimated fishery-related mortality of common dolphins attributable to the *Loligo* squid portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries was 0 between 1997-1998 and 49 in 1999 (CV=0.97). After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

In the Atlantic mackerel portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries, the estimated fishery-related mortality was 161 (CV=0.49) animals in 1997 and 0 in 1998 and 1999. However, the estimates in both the mackerel and *Loligo* fisheries should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl and mid-Atlantic mid-water trawl fisheries.

There was one observed take in the Southern New England/mid-Atlantic Bottom Trawl fishery reported in 1997. The estimated fishery-related mortality for common dolphins attributable to this fishery was 93 (CV=1.06) in 1997 and 0 in 1998 and 1999. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

Northeast Sink Gillnet

In 1990, an observer program was started by NMFS to investigate marine mammal takes in the Northeast sink gillnet fishery (Appendix III). Bycatch in the northern Gulf of Maine occurs primarily from June to September, while in the southern Gulf of Maine, bycatch occurs from January to May and September to December. Four common dolphins were observed taken in northeast sink gillnet fisheries in 2005, one in 2006, one in 2007, ~~and~~ two in 2008 and 3 in 2009. The estimated annual fishery-related mortality and serious injury attributable to the northeast sink gillnet fishery (CV in parentheses) was 0 in 1995, 63 in 1996 (1.39), 0 in 1997, 0 in 1998, 146 in 1999 (0.97), 0 in 2000-2004, 5 (0.80) in 2005, 20 (1.05) in 2006, 11 (0.94) in 2007, ~~and~~ 34 (0.~~.~~77) in 2008, and 43 (0.77) in 2009. The ~~2004~~2005-~~2008~~ 2009 average annual mortality attributed to the northeast sink gillnet was ~~18~~ 26 animals (CV=0.~~45~~39). ~~This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, some of which operate right off the beach. The number of vessels in this fishery is unknown, because records which are held by both state and federal agencies have not been centralized and standardized.~~

A study of the effects of two different hanging ratios in the bottom set monkfish gillnet fishery on the bycatch of cetaceans and pinnipeds was conducted by NEFSC in 2009 and 2010 with 100% observer coverage. Commercial fishing vessels from Massachusetts and New Jersey were used for the study which took place south of the Harbor Porpoise Take Reduction Team Cape Cod South Management Area (south of 40° 40´) in February, March and April. Eight research strings of fourteen nets each were fished, and 159 hauls were completed during the course of the study. Results showed that while a 0.33 mesh performed better at catching commercially important finfish than a 0.50 mesh, there was no statistical difference in cetacean or pinniped bycatch rates between the two hanging ratios. One common dolphin was caught in this study during 2009 (Schnaittacher 2011).

Mid-Atlantic Gillnet

One common dolphin was taken in an observed trip during 2006. Two common dolphins were observed taken in 1995, 1996 and 1997, and no takes were observed from 1998 to 2005, or in 2007 - ~~2008~~2009. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 7.4 in 1995 (0.69), 43 in 1996 (0.79), 16 in 1997 (0.53), and 0 in 1998-2005, 11 (1.03) in 2006, 0 in 2007~~, and 0 in 2008~~ - 2009. Average annual estimated fishery-related mortality attributable to this fishery during ~~2004~~2005-~~2008~~ 2009 was 2 (CV=1.03) common dolphins (Table 2).

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. One common dolphin was observed taken in 2002, 3 in 2004, 5 in 2005, 1 in 2006, 3 in 2007, ~~and~~ 1 in 2008, and 5 in 2009~~.~~ (Table 2). The estimated annual fishery-related mortality and serious injury attributable to the northeast bottom trawl fishery (CV in parentheses) was 27 in 2000 (0.29), 30 (0.30) in 2001, 26 (0.29) in 2002, 26 (0.29) in 2003, 26 (0.29) in 2004, 32 (0.28) in 2005, 25 in 2006, 24 (0.28) in 2007, ~~and~~ 17 (0.29) in 2008, and 19 (0.30) in 2009. The ~~2004~~2005-~~2008~~ 2009 average annual mortality attributed to the northeast bottom trawl was ~~25~~ 23 animals (CV=0.13).

Mid-Atlantic Bottom Trawl

Three common dolphins were observed taken in mid-Atlantic bottom trawl fisheries in 2000, 2 in 2001, 9 in 2004, 15 in 2005, 14 in 2006, 0 in 2007, ~~and~~ 1 in 2008, and 12 in 2009 (Table 2). The estimated annual fishery-related mortality and serious injury attributable to the northeast bottom trawl fishery (CV in parentheses) was 93 in 2000 (0.26), 103 (0.27) in 2001, 87 (0.27) in 2002, 99 (0.28) in 2003, 159 (0.30) in 2004, 141 (0.29) in 2005, 131 (0.28) in 2006, 66 (0.27) in 2007, ~~and~~ 108 (0.28) in 2008, and 104 (0.29) in 2009. The ~~2004~~2005-~~2008~~ 2009 average annual mortality attributed to the mid-Atlantic bottom trawl was ~~121~~ 110 animals (CV=0.13).

Mid-Atlantic Mid-water Trawl Fishery (Including Pair Trawl)

2007 was the first year a short-beaked common dolphin mortality had been observed in this fishery. This animal was taken in the same haul as an Atlantic white-sided dolphin. Due to small sample sizes, the bycatch rate model used the 2003 to September 2007 observed mid-water trawl data, including paired and single, and northeast and mid-Atlantic mid-water trawls (Palka, pers. com.). The model that best fit these data was a Poisson logistic regression model that included latitude and bottom depth as significant explanatory variables, where soak duration was the unit of effort. The resultant estimated annual fishery-related mortality and serious injury (CV in parentheses) was 3.2 (0.70) for 2007. The ~~2004~~2005-~~2008~~ 2009 average annual mortality attributed to the mid-Atlantic mid-water trawl was 1 (0.70) animal.

Pelagic Longline

In 2009 a common dolphin mortality was observed in the pelagic longline fishery, mid-Atlantic Bight fishing area (Garrison and Stokes 2010). The extrapolated estimate (CV in parentheses) for common dolphin bycatch attributed to this fishery was 8.5 (1.0) for 2009. The 2005-2009 average annual mortality was 1.7 (1.0).

Table 2. Summary of the incidental mortality of short-beaked common dolphins (*Delphinus delphis delphis*) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery [a]	Years	Data Type [b]	Observer Coverage [c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet[e]	~~04~~05-~~08~~09	Obs. Data, Trip Logbook, Allocated Dealer Data	~~.06,~~ .07, .04, .07, .05, .04	0, 0, 0, 0, 0	~~0,~~ 4, 1, 1, 2, 3	0, 0, 0, 0, 0	~~0,~~ 26, 20, 11, 34, 43	~~0,~~ 26, 20, 11, 34, 43	~~0,~~ .8, 1.05, .94, .77, .77	~~18~~ 26 (0.~~45~~39)
Mid-Atlantic Gillnet	~~04~~05-~~08~~09	Obs. Data, Trip Logbook, Allocated Dealer Data	~~.01,~~ .02, .03, .04, .03, .03	0, 0, 0, 0, 0	~~0,~~ 0, 1, 0, 0, 0	0, 0, 0, 0, 0	~~0,~~ 0, 11, 0, 0, 0	0, 0, 11, 0, 0, 0	~~0,~~ 0, 1.03, 0, 0, 0	2.2 (1.03)
Mid-Atlantic Mid-water Trawl - Including Pair Trawl	~~04~~05-~~08~~09	Obs. Data Weighout Trip Logbook	~~.064,~~ .084, .089, .039, .13, .13	0, 0, 0, 0, 0	~~0,~~ 0, 0, 1, 0, 0	0, 0, 0, 0, 0,	~~0,~~ 0, 0, 3.2, 0, 0	~~0,~~ 0, 0, 3.2, 0, 0	~~0,~~ 0, 0, 0, .70, 0, 0	~~1~~ 0.6 (.70)
Northeast Bottom Trawl [d]	~~04~~05-~~08~~09	Obs. Data Dealer Data VTR Data	~~.05,~~ .12, .06, .06, .08, .09	0, 0, 0, 0, 0	~~3,~~ 5, 1, 3, 1, 5	0, 0, 0, 0, 0	~~26,~~ 32, 25, 24, 17, 19	~~26,~~ 32, 25, 24, 17, 19	~~.29,~~ .28, .28, .28, .29, .30	~~25~~ 23 (.13)
Mid-Atlantic Bottom Trawl [d]	~~04~~05-~~08~~09	Obs. Data Dealer	~~.03 ,~~ .03, .02, .03, .03, .05	0, 0, 0, 0 , 0	~~9,~~ 15, 14, 0, 1, 12	0, 0, 0, 0, 0	~~159,~~ 141, 131, 66, 108, 104	~~159,~~ 141, 131, 66, 108, 104	~~.30,~~ .29, .28, .27, .28, .29	~~121~~ 110 (.13)
Pelagic Longline [b]	05-09	Obs. Data Logbook	.06, .07, .07, .07, .10	0, 0, 0, 0, 0	0, 0, 0, 0, 1	0, 0, 0, 0, 0	0, 0, 0, 0, 8.5	0, 0, 0, 0, 8.5	0, 0, 0, 0, 1.0	1.7 (1.0)

TOTAL		~~167~~ 164 (.~~11~~12)

a. The fisheries listed in Table 2 reflect new definitions defined by the proposed List of Fisheries for 2005 (FR Vol. 69, No. 231, 2004). The 'North Atlantic bottom trawl' fishery is now referred to as the 'Northeast bottom trawl. The Illex, Loligo and Mackerel fisheries are now part of the 'mid-Atlantic bottom trawl' and 'mid-Atlantic midwater trawl' fisheries.
b. Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Fisheries Observer Program. NEFSC collects landings data (Dealer reported data) which are used as a measure of total landings and mandatory Vessel Trip Reports (VTR) (Trip Logbook) that are used to determine the spatial distribution of landings and fishing effort.
c. The observer coverages for the Northeast sink gillnet fishery are ratios based on tons of fish landed. North Atlantic bottom trawl mid-Atlantic bottom trawl, and mid-Atlantic mid-water trawl fishery coverages are ratios based on trips.
d. NE and MA bottom trawl mortality estimates reported for 2007 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2007 effort. NE and MA bottom trawl mortality estimates reported for 2008 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2008 effort. NE and MA bottom trawl mortality estimates reported for 2009 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2009 effort (Rossman 2010). Because of this pooling, years with no observed mortality may still have a calculated estimate.
e. One common dolphin was incidentally caught as part of a 2009 NEFSC hanging ratio study to examine the impact of gillnet hanging ratio on harbor porpoise bycatch. This animal was included in the observed interactions and added to the total estimates, though thisinteraction and its associated fishing effort were not included in bycatch rate calculations.

CANADA

Between January 1993 and December 1994, 36 Spanish deep water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets), were observed in NAFO Fishing Area 3 (off the Grand Banks) (Lens 1997). A total of 47 incidental catches were recorded, which included one common dolphin. The incidental mortality rate for common dolphins was 0.007/set.

Other Mortality

Two common dolphins were reported as incidental mortalities in NEFSC Atlantic herring monitoring activities in 2004. In 2007, one common dolphin was reported taken in a NEFSC spring bottom trawl survey.

From ~~2004~~ 2005 to ~~2008~~2009, ~~414~~ 428 common dolphins were reported stranded between Maine and Florida (Table 3). The total includes mass stranded common dolphins in Massachusetts during ~~2004 (one event of 6 animals and one of 3 animals),~~ 2005 (a total of 43 in 4 separate events), 2006 (a total of 65 in 10 events), 2007 (a total of 23 in 5 separate events), ~~and~~ 2008 (one event of 5 animals and one of 2 animals) and 2009 (a total of 26 in 6 events). Five of the 2005 Massachusetts stranded animals, 18 animals in 2006, 2 animals in 2007, ~~and~~ 2 animals in 2008 and 5 animals in 2009 were released alive. ~~Common dolphins were included in the UME (unusual mortality event) declared for Virginia in 2004 (MMC 2005). The strandings were primarily bottlenose dolphins, but common dolphins were also involved.~~ Human interactions were indicated on one ~~of the 2004 Virginia common dolphin mortality records, one~~ of the 2005 and one of the 2007 New York mortality records and one of the 2006 Virginia mortality records. In 2008, seven common dolphins had indications of human interactions, four which were fishery interactions. In 2009, six common dolphins had indications of human interaction, 3 of which were classified as fishery interactions. An Unusual Mortality Event (UME) was declared in 2008 due to a relatively high number of strandings between January and April 2008, from New Jersey to North Carolina. Twenty seven common dolphins were involved in this event (http://www.nmfs.noaa.gov/pr/health/mmume/midatlantic2008.htm accessed 19 April 2011).

Four common dolphin strandings (6 individuals) were reported on Sable Island, Nova Scotia from 1996 to 1998 (Lucas and Hooker 1997; 2000). ~~One common dolphin~~The Marine Animal Response Society of Nova Scotia ~~was~~ reported one common dolphin stranded ~~in Halifax County, Nova Scotia~~ in ~~2005~~ 2008 and one ~~was reported stranded~~ in ~~2008~~ 2009 (Tonya Wimmer, pers. comm.).

~~Table 3. Short-beaked common dolphin (*Delphinus delphis*) reported strandings along the U.S. Atlantic coast, 2004-2008.~~

~~STATE~~	~~2004~~	~~2005~~	~~2006~~	~~2007~~	~~2008~~	~~TOTALS~~
~~Maine~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~1~~
~~Massachusetts~~[a]	~~26~~	~~64~~	~~100~~	~~65~~	~~19~~	~~274~~

~~Rhode Island~~	~~1~~	~~0~~	~~2~~	~~4~~	~~3~~	~~10~~
~~New York [b, c]~~	~~3~~	~~4~~	~~3~~	~~23~~	~~2~~	~~35~~
~~New Jersey~~	~~17~~	~~4~~	~~2~~	~~4~~	~~9~~	~~36~~
~~Delaware[c]~~	~~2~~	~~1~~	~~0~~	~~0~~	~~2~~	~~5~~
~~Maryland~~	~~5~~	~~0~~	~~0~~	~~0~~	~~2~~	~~7~~
~~Virginia[b, c]~~	~~8~~	~~2~~	~~1~~	~~4~~	~~22~~	~~37~~
~~North Carolina[c]~~	~~4~~	~~1~~	~~2~~	~~0~~	~~1~~	~~8~~
~~EZ~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~
~~TOTALS~~	~~67~~	~~76~~	~~110~~	~~101~~	~~60~~	~~414~~

~~a. Massachusetts mass strandings (2004 - 6 and 3; 2005 - 7,5,25, and 4; 2006 - 2,2,3,4,4,3,9,10,14, and 14; 2007 - 9,2,4,6,2; 2008 - 5 and 2).~~

~~b. Virginia reports 1 common dolphin found in a pound net in 2004. One common dolphin was released alive from a pound net in 2006 in NY. Twenty (12 dead, 8 rescued; one of the mortalities classified as human interaction) animals involved in a mass stranding in Suffolk county in 2007. Seven animals involved in 2 mass stranding events in March 2009 (six euthanized, 1 died at site, 2 had signs of fishery interaction). In addition, in 2008 3 animals were relocated from the Nansemond River.~~

~~c. One 2005 mortality in New York reported as having human interaction and one in VA in 2006. Seven records with signs of human interaction in 2008 - 3 from Virginia, 1 from Massachusetts, one from North Carolina, and one from Delaware. Of these, 4 were fishery interactions.~~

Table 3. Short-beaked common dolphin (*Delphinus delphis delphis*) reported strandings along the U.S. Atlantic coast, 2005-2009.

STATE	**2005**	**2006**	**2007**	**2008**	**2009**	**TOTALS**
Maine	0	0	1	0	0	1
Massachusetts[a]	64	100	65	19	53	301
Rhode Island[c]	0	2	4	3	6	15
New York [b, c]	4	3	23	2	7	39
New Jersey	4	2	4	9	7	26
Delaware[c]	1	0	0	2	4	7
Maryland	0	0	0	2	2	4
Virginia[c]	2	1	4	22	2	31
North Carolina[c]	1	2	0	1	0	4
EZ	0	0	0	0	0	0
TOTALS	76	110	101	60	81	428

a. Massachusetts mass strandings (2005 - 7,5,25, and 4; 2006 - 2,2,3,4,4,3,9,10,14, and 14; 2007 - 9,2,4,6,2; 2008 - 5 and 2; 2009 - 2,3, ~~3,~~4,6,8).

b. One common dolphin was released alive from a pound net in 2006 in New York. Twenty (12 dead, 8 rescued; one of the mortalities classified as human interaction) animals involved in a mass stranding in Suffolk county in 2007. Seven animals involved in 2 mass stranding events in March 2009 (six euthanized, 1 died at site, 2 had signs of fishery interaction). In addition, in 2008 3 animals were relocated from the Nansemond River.

c. One 2005 mortality in New York reported as having human interaction and one in VA in 2006. Seven records with signs of human interaction in 2008 - 3 from Virginia, 1 from Massachuisetts, one from North Carolina, and one from Delaware. Of these, 4 were fishery interactions. Six human interaction cases in 2009 (2 Massachusetts, 3 Rhode Island, 1 New York), 3 of which were classified as fishery interactions (2 in Rhode Island and one in Massachusetts).

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

STATUS OF STOCK

The status of short-beaked common dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The ~~2004~~2005-~~2008~~ 2009 average annual human-related mortality does not exceed PBR; therefore, this is not a strategic stock.

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~~November 2010~~~~January~~August 2011

HARBOR PORPOISE (*Phocoena phocoena phocoena)*: Gulf of Maine/Bay of Fundy Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

This stock is found in U.S. and Canadian Atlantic waters. The distribution of harbor porpoises has been documented by sighting surveys, strandings and takes reported by NMFS observers in the Sea Sampling Program. During summer (July to September), harbor porpoises are concentrated in the northern Gulf of Maine and southern Bay of Fundy region, generally in waters less than 150 m deep (Gaskin 1977; Kraus *et al.* 1983; Palka 1995a; Palka 1995b), with a few sightings in the upper Bay of Fundy and on ~~the northern edge of~~ Georges Bank (Palka 2000). During fall (October-December) and spring (April-June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south. They are seen from the coastline to deep waters (>1800 m; Westgate *et al.* 1998), although the majority of the population is found over the continental shelf. During winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada. There does not appear to be a temporally coordinated migration or a specific migratory route to and from the Bay of Fundy region. However, during the fall, several satellite tagged harbor porpoises did favor the waters around the 92-m isobath, which is consistent with observations of high rates of incidental catches in this depth range (Read and Westgate 1997). There were two stranding records from Florida during the 1980s (Smithsonian strandings database) and one in 2003 (NE Regional Office/NMFS strandings and entanglement database).

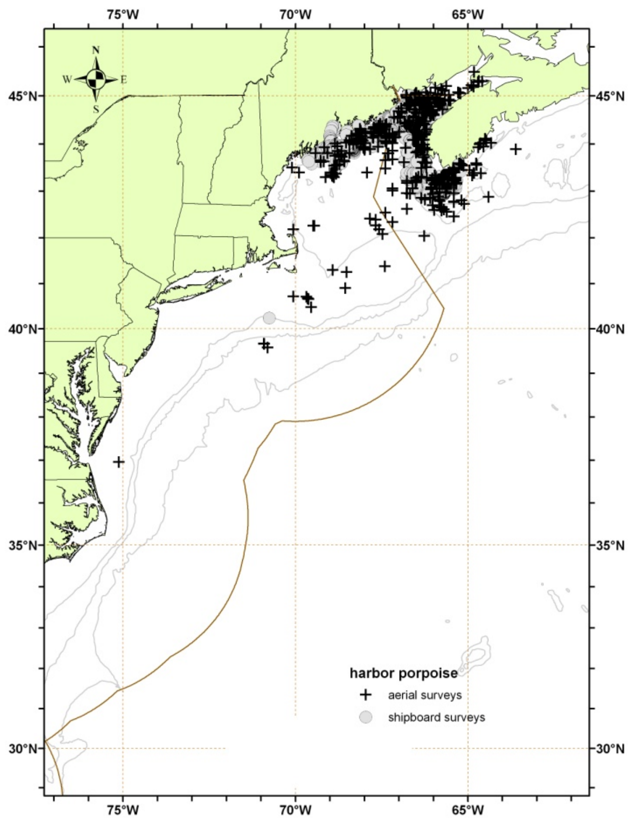

Figure 1. *Distribution of harbor porpoises from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.*

Gaskin (1984, 1992) proposed that there were four separate populations in the western North Atlantic: the Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland populations. Analyses involving mtDNA (Wang *et al.* 1996; Rosel *et al.* 1999a; ~~Rosel *et al.*~~ 1999b), organochlorine contaminants (Westgate *et al.* 1997; Westgate and Tolley 1999), heavy metals (Johnston 1995), and life history parameters (Read and Hohn 1995) support Gaskin's proposal. Genetic studies using mitochondrial DNA (Rosel *et al.* 1999a) and contaminant studies using total PCBs (Westgate and Tolley 1999) indicate that the Gulf of Maine/Bay of Fundy females were distinct from females from the other populations in the Northwest Atlantic. Gulf of Maine/Bay of Fundy males were distinct from Newfoundland and Greenland males, but not from Gulf of St. Lawrence males according to studies comparing mtDNA (Palka *et al.* 1996; Rosel *et al.* 1999a) and CHLORs, DDTs, PCBs and CHBs (Westgate and Tolley 1999). Nuclear microsatellite markers have also been applied to samples from these four populations, but this analysis failed to detect significant population sub-division in either sex (Rosel *et al.* 1999a). These patterns may be indicative of female philopatry coupled with dispersal of males. Both mitochondrial DNA and microsatellite analyses indicate that the Gulf of Maine/Bay of Fundy stock is not the sole contributor to the aggregation of porpoises found in off the mid-Atlantic states during winter (Rosel *et al.* 1999a; Hiltunen 2006). Mixed-stock analyses using twelve microsatellite loci in both Bayesian and likelihood frameworks indicate that the Gulf of Maine/Bay of Fundy is the largest contributor (~60%), followed by Newfoundland (~25%) and then the Gulf of St. Lawrence (~12%), with Greenland making a small contribution (<3%). For Greenland, the lower confidence interval of the likelihood analysis includes zero. For the Bayesian analysis, the lower 2.5% posterior quantiles include zero for both Greenland and the Gulf of St. Lawrence. Intervals that reach zero provide the possibility that these populations contribute no animals to the mid-Atlantic aggregation. This report follows Gaskin's hypothesis on harbor porpoise stock structure in the western North Atlantic, where the Gulf of Maine and Bay of Fundy harbor porpoises are recognized as a single management stock separate from harbor porpoise populations in the Gulf of St. Lawrence, Newfoundland, and Greenland.

POPULATION SIZE

To estimate the population size of harbor porpoises in the Gulf of Maine/Bay of Fundy region, eight line-transect sighting surveys were conducted during the summers of 1991, 1992, 1995, 1999, 2002, 2004, 2006, and 2007. The best current abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock is 89,054 (CV=0.47), based on the 2006 survey results (Table 1). This is because the 2006 estimate covered the largest portion of the harbor porpoise range.

~~An abundance estimate of 64,047 (CV=0.48) harbor porpoises was derived from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1). The value of g(0) used for this estimation was derived from the pooled 2002, 2004 and 2006 aerial survey data.~~

Earlier abundance estimates

Please see Appendix IV for earlier abundance estimates. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), if estimates are older than eight years PBR is undetermined.

Recent surveys and abundance estimates

An abundance estimate of 51,520 (CV=0.65) harbor porpoises was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the 100-m depth contour on the southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed (Table 1). Shipboard data were collected using the two two-independent independent-team line-transect method and analyzed using the modified direct-duplicate method (Palka 1995b) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the trackline. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

An abundance estimate of 89,054 (CV=0.47) harbor porpoises was generated from an aerial survey conducted in August 2006 which surveyed 10,676 km of trackline in the region from the 2000 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; ~~Palka pers. comm~~NMFS 2006.).

An abundance estimate of 4,862 (95%CI=2,204-8,801) harbor porpoises from the Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, and Newfoundland stocks was generated from the Canadian Trans North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases. (Lawson ,and Gosselin 2009).

Table 1. Summary of recent abundance estimates for the Gulf of Maine/Bay of Fundy harbor porpoise. Month, year, and area covered during each abundance survey and the resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
~~Aug 2002~~	~~S. Gulf of Maine to Maine~~	~~64,047~~	~~0.48~~
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	51,520	0.65

Table 1. Summary of recent abundance estimates for the Gulf of Maine/Bay of Fundy harbor porpoise. Month, year, and area covered during each abundance survey and the resulting abundance estimate (N_{best}) and coefficient of variation (CV).			
Month/Year	**Area**	**N_{best}**	**CV**
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	89,054	0.47
Jul-Aug 2007	Northern Labrador-Scotian Shelf[a]	4,862	0.31
a. Estimate includes harbor porpoises from the Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, and Newfoundland stocks			

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for harbor porpoises is 89,054 (CV=0.47). The minimum population estimate for the Gulf of Maine/Bay of Fundy harbor porpoise is 60,970.

Current Population Trend

A trend analysis has not been conducted for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Several attempts have been made to estimate potential population growth rates. Barlow and Boveng (1991), who used a re-scaled human life table, estimated the upper bound of the annual potential growth rate to be 9.4%. Woodley and Read (1991) used a re-scaled Himalayan tahr life table to estimate a likely annual growth rate of 4%. In an attempt to estimate a potential population growth rate that incorporates many of the uncertainties in survivorship and reproduction, Caswell *et al.* (1998) used a Monte Carlo method to calculate a probability distribution of growth rates. The median potential annual rate of increase was approximately 10%, with a 90% confidence interval of 3-15%. This analysis underscored the considerable uncertainty that exists regarding the potential rate of increase in this population. Moore and Read (2008) conducted a Bayesian population modeling analysis to estimate the potential population growth of harbor porpoise in the absence of bycatch mortality. Their method used fertility data, in combination with age-at-death data from stranded animals and animals taken in gillnets, and was applied under two scenarios to correct for possible data bias associated with observed bycatch of calves. Demographic parameter estimates were ‘model averaged’ across these scenarios. The Bayesian posterior median estimate for potential natural growth rate was 0.046. This last, most recent, value will be the one used for the purpose of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a “recovery” factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 60,970. The maximum productivity rate is 0.046. The “recovery” factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the Gulf of Maine/Bay of Fundy harbor porpoise is 703.

ANNUAL HUMAN-CAUSED MORTALITY

Data to estimate the mortality and serious injury of harbor porpoise come from U.S. and Canadian Sea Sampling Programs, from records of strandings in U.S. and Canadian waters, and from records in the Marine Mammal Authorization Program (MMAP). See Appendix III for details on U.S. fisheries and data sources. Estimates using Sea Sampling Program and MMAP data are discussed by fishery under the Fishery Information section (Table 2). Strandings records are discussed under the Unknown Fishery in the Fishery Information section (Table 3) and under the Other Mortality section (Table 43).

The total annual estimated average human-caused mortality is ~~928~~927 ~~± (CV=0.16)~~ harbor porpoises per year. This is derived from ~~four~~ two components: ~~877~~ 883 harbor porpoise per year (CV=0.~~15~~14) from ~~most~~ U.S. fisheries using observer and MMAP data, ~~an unknown number for the Northeast bottom trawl fishery,~~ and ~~45~~ 44 per year (unknown CV) from Canadian fisheries using observer data~~, and 6 per year from unknown U.S. fisheries using strandings data~~.

Fishery Information

Recently, Gulf of Maine/Bay of Fundy harbor porpoise takes have been documented in the U.S. Northeast sink gillnet, mid-Atlantic gillnet, and Northeast bottom trawl fisheries and in the Canadian Bay of Fundy groundfish sink gillnet and herring weir fisheries (Table 2). Detailed U.S. fishery information is reported in Appendix III.

Earlier Interactions

One harbor porpoise was observed taken ~~from~~ in the Atlantic pelagic drift gillnet fishery during 1991-1998; the fishery ended in 1998. This observed bycatch was notable because it occurred in continental shelf edge waters adjacent to Cape Hatteras (Read *et al.* 1996). Estimated annual fishery-related mortality (CV in parentheses) attributable to this fishery was 0.7 in 1989 (7.00), 1.7 in 1990 (2.65), 0.7 in 1991 (1.00), 0.4 in 1992 (1.00), 1.5 in 1993 (0.34), 0 during 1994-1996 and 0 in 1998. The fishery was closed during 1997.

U.S.

Northeast Sink Gillnet

~~In 1984 the Northeast sink gillnet fishery was investigated by a sampling program that collected information concerning marine mammal bycatch. Approximately 10% of the vessels fishing in Maine, New Hampshire, and Massachusetts were sampled. Among the 11 gillnetters who received permits and logbooks, 30 harbor porpoises were reported caught. It was estimated, using rough estimates of fishing effort, that a maximum of 600 harbor porpoises were killed annually in this fishery (Gilbert and Wynne 1985; Gilbert 1987).~~

In 1990, an observer program was started by NMFS to investigate marine mammal takes in the Northeast sink gillnet fishery (Appendix III). Bycatch in the northern Gulf of Maine occurs primarily from June to September, while in the southern Gulf of Maine, bycatch occurs from January to May and September to December. Estimated annual bycatch (CV in parentheses) from this fishery ~~during 1990-2007~~ was 2,900 in 1990 (0.32), 2,000 in 1991 (0.35), 1,200 in 1992 (0.21), 1,400 in 1993 (0.18) (CUD 1994; Bravington and Bisack 1996), 2,100 in 1994 (0.18), 1,400 in 1995 (0.27) (Bisack 1997), 1,200 in 1996 (0.25), 782 in 1997 (0.22), 332 in 1998 (0.46), 270 in 1999 (0.28) (Rossman and Merrick 1999), 507 in 2000 (0.37), 53 (0.97) in 2001, 444 (0.37) in 2002, 592 (0.33) in 2003, 654 (0.36) in 2004, 630 (0.23) in 2005, 514 (0.31) in 2006, 395 (0.37) in 2007, ~~and~~ 666 (0.48) in 2008, and 591 (0.23) in 2009 (Table 2). There appeared to be no evidence of differential mortality in U.S. or Canadian gillnet fisheries by age or sex in animals collected before 1994, although there was substantial inter-annual variation in the age and sex composition of the bycatch (Read and Hohn 1995). Using observer data collected during 1990-1998 and a logit regression model, females were 11 times more likely to be caught in the offshore southern Gulf of Maine region, males were more likely to be caught in the south Cape Cod region, and the overall proportion of males and females caught in a gillnet and brought back to land were not significantly different from 1:1 (Lamb 2000).

Scientific experiments that demonstrated the effectiveness of pingers in the Gulf of Maine were conducted during 1992 and 1993 (Kraus *et al.* 1997). After the scientific experiments, experimental fisheries were allowed in the general fishery during 1994 to 1997 in various parts of the Gulf of Maine and south of Cape Cod areas. During these experimental fisheries, bycatch rates of harbor porpoises in pingered nets were less than in non-pingered nets.

A study on the effects of two different hanging ratios in the bottom-set monkfish gillnet fishery on the bycatch of cetaceans and pinnipeds was conducted by NEFSC in 2009 and 2010 with 100% observer coverage. Commercial fishing vessels from Massachusetts and New Jersey were used for the study, which took place south of the Harbor Porpoise Take Reduction Team Cape Cod South Management Area (south of 40° 40´) in February, March and April. Eight research strings of fourteen nets each were fished and, 159 hauls were completed during the course of the study. Results showed that while a 0.33 mesh performed better at catching commercially important finfish than a 0.50 mesh, there was no statistical difference in cetacean or pinniped bycatch rates between the two hanging ratios. Twelve harbor porpoises were caught in this project during 2009 (Schnaittacher 2011).

Average estimated harbor porpoise mortality and serious injury in the Northeast sink gillnet fishery during 1994-1998, before the Take Reduction Plan, was 1,163 (0.11). The average annual harbor porpoise mortality and serious injury in the Northeast sink gillnet fishery from ~~2004~~ 2005 to ~~2008~~ 2009 was ~~572~~ 559 (0.~~17~~16) (Table 2).

Mid-Atlantic Gillnet

Before an observer program was in place for this fishery, Polacheck *et al.* (1995) reported one harbor porpoise incidentally taken in shad nets in the York River, Virginia. In July 1993 an observer program was initiated in the mid-Atlantic gillnet fishery by the NEFSC Sea Sampling program (Appendix III). Documented bycatch after 1995

~~were~~ was from December to May. Bycatch estimates were calculated using methods similar to that used for bycatch estimates in the Northeast sink gillnet fishery (Bravington and Bisack 1996; Bisack 1997). The estimated annual mortality (CV in parentheses) attributed to this fishery was 103 (0.57) for 1995, 311 (0.31) for 1996, 572 (0.35) for 1997, 446 (0.36) for 1998, 53 (0.49) for 1999, 21 (0.76) for 2000, 26 (0.95) for 2001, unknown in 2002, 76 (1.13) in 2003, 137 (0.91) in 2004, 470 (0.51) in 2005, 511 (0.32) in 2006, 58 (1.03) in 2007, ~~and~~ 350 (0.75) in 2008, and 201 (0.55) in 2009. Annual average estimated harbor porpoise mortality and serious injury from the mid-Atlantic gillnet fishery during 1995 to 1998, before the Take Reduction Plan, was 358 (CV=0.20). The average annual harbor porpoise mortality and serious injury in the mid-Atlantic gillnet fishery from ~~2004~~ 2005 to ~~20087~~ 2009 was ~~305~~ 318 (0.~~27~~26) (Table 2).

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. Twenty harbor porpoise mortalities were observed in the Northeast bottom trawl fishery between 1989 and 2008, but many of these are not attributable to this fishery. Decomposed animals are presumed to have been dead prior to being taken by the trawl. One fresh dead take was observed in the Northeast bottom trawl fishery in 2003, 4 in 2005, 1 in 2006, and 1 in 2008. Estimates have not been generated for this fishery. To estimate bycatch in this fishery, o~~Estimates have not been generated for this fishery.~~bserver and mandatory vessel trip report data from the years 2005 through 2009 were used in a stratified ratio-estimator. The estimated annual mortality (CV in parentheses) attributed to this fishery was 7.2 (0.48) for 2005, 6.5 (0.49) for 2006, 5.6 (0.46) for 2007, 5.3 (0.47) for 2008, and 5.1 (0.50) for 2009. Annual average estimated harbor porpoise mortality and serious injury from the northeast bottom trawl fishery from 2005 to 2009 was 6.0 (0.22) (Table 2).

Unknown Fishery

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported 228, 27, 113, 79, 122, 118, ~~174~~175, 73, 79, ~~and~~ 58, and 65 stranded harbor porpoises on U.S. beaches during 1999 to ~~2008~~2009, respectively (see Other Mortality section for more details). Of these, it was determined that the cause of death of 19, 1, 3, 2, 9, and 6 stranded harbor porpoises in 1999 to 2004, respectively, were due to unknown fisheries and these animals were in areas and times that were not included in the above mortality estimate derived from observer program data. ~~(Table 3). As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. The harbor porpoise mortality and serious injury in this unknown fishery category for 2004 is 6.0 (CV is unknown).~~

CANADA

Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on 25-40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. No harbor porpoises were observed taken.

Bay of Fundy Sink Gillnet

During the early 1980s, harbor porpoise bycatch in the Bay of Fundy sink gillnet fishery, based on casual observations and discussions with fishermen, was thought to be low. The estimated harbor porpoise bycatch in 1986 was 94-116 and in 1989 it was 130 (Trippel *et al.* 1996). The Canadian gillnet fishery occurs mostly in the western portion of the Bay of Fundy during the summer and early autumn months, when the density of harbor porpoises is highest. Polacheck (1989) reported there were 19 gillnetters active in 1986, 28 active in 1987, and 21 in 1988.

More recently, an observer program implemented in the summer of 1993 provided a total bycatch estimate of 424 harbor porpoises (± 1 SE: 200-648) from 62 observed trips, (approximately 11.3% coverage of the Bay of Fundy trips) (Trippel *et al.* 1996). During 1994, the observer program was expanded to cover 49% of the gillnet trips (171 observed trips). The bycatch was estimated to be 101 harbor porpoises (95% confidence limit: 80-122), and the fishing fleet consisted of 28 vessels (Trippel *et al.* 1996). During 1995, due to groundfish quotas being exceeded, the gillnet fishery was closed from July 21 to August 31. During the open fishing period of 1995, 89% of the trips were observed, all in the Swallowtail region. Approximately 30% of these observed trips used pingered nets. The estimated bycatch was 87 harbor porpoises (Trippel *et al.* 1996). No confidence interval was computed due to lack of coverage in the Wolves fishing grounds. During 1996, the Canadian gillnet fishery was closed during 20-31 July and 16-31 August due to groundfish quotas. From the 107 monitored trips, the bycatch in 1996 was estimated to be

20 harbor porpoises (DFO 1998; Trippel *et al.* 1999). Trippel *et al.* (1999) estimated that during 1996, gillnets equipped with acoustic alarms reduced harbor porpoise bycatch rates by 68% over nets without alarms in the Swallowtail area of the lower Bay of Fundy. During 1997, the fishery was closed to the majority of the gillnet fleet during 18-31 July and 16-31 August, due to groundfish quotas. In addition a time-area closure to reduce porpoise bycatch in the Swallowtail area occurred during 1-7 September 1-7. From the 75 monitored trips, 19 harbor porpoises were observed taken. After accounting for total fishing effort, the estimated bycatch in 1997 was 43 animals (DFO 1998). Trippel *et al.* (1999) estimated that during 1997, gillnets equipped with acoustic alarms reduced harbor porpoise bycatch rates by 85% over nets without alarms in the Swallowtail area of the lower Bay of Fundy. The number of monitored trips (and observed harbor porpoise mortalities were 111 (5) for 1998, 93 (3) for 1999, 194 (5) for 2000, and 285 (39) for 2001. The estimated annual mortality estimates were 38 for 1998, 32 for 1999, 28 for 2000, and 73 for 2001 (Trippel and Shepherd 2004). Estimates of variance are not available.

There has been no observer program during the summer since 2002 in the Bay of Fundy region, but the fishery was active. Bycatch for these years is unknown. -The annual average of most recent five years with available data (1997-2001) was 43 animals, so this value is used to estimate the annual average for more recent years.

Herring Weirs

Harbor porpoises are taken in Canadian herring weirs, but there have been no recent efforts to observe takes in the U.S. component of this fishery. Smith *et al.* (1983) estimated that in the 1980s approximately 70 harbor porpoises became trapped annually and, on average, 27 died annually. In 1990, at least 43 harbor porpoises were trapped in Bay of Fundy weirs (Read *et al.* 1994). In 1993, after a cooperative program between fishermen and Canadian biologists was initiated, over 100 harbor porpoises were released alive (Read *et al.* 1994). Between 1992 and 1994, this cooperative program resulted in the live release of 206 of 263 harbor porpoises caught in herring weirs. Mortalities (and releases) were 11 (50) in 1992, 33 (113) in 1993, and 13 (43) in 1994 (Neimanis *et al.* 1995). Since that time, additional 751 harbor porpoises have been documented in Canadian herring weirs of which 728 were released or escaped, 42 died, and 29 had an unknown status. where the number of mMortalities (and releases, and unknowns) were 5 (60, 0) in 1995; 2 (4, 0) in 1996; 2 (24, 0) in 1997; 2 (26, 0) in 1998; 3 (89, 0) in 1999; 0 (13, 0) in 2000 (A. Read, pers. comm), 14 (296, 0) in 2001, 3 (46, 4) in 2002, 1 (26, 3) in 2003, 4 (53, 2) in 2004; 0 (19, 5) in 2005; 2 (14, 0) in 2006; 3 (9, 3) in 2007, and 0 (8, 6) in 2008, and 0 (3,4) in 2009 (Neimanis *et al.* 2004; H. Koopman and A. Westgate, pers. comm.).

Average estimated harbor porpoise mortality in the Canadian herring weir fishery during 20042005-2008 2009 was 1.81.0 (Table 2). An estimate of variance is not possible.

Gulf of St. Lawrence gillnet

This fishery interacts with the Gulf of St. Lawrence harbor porpoise stock, not the Gulf of Maine/Bay of Fundy harbor porpoise stock. Using questionnaires to fishermen, Lesage *et al.* (2006) determined a total of 2215 (95% CI 1151-3662) and 2394 (95% CI 1440-3348) harbor porpoises were taken in 2000 and 2001, respectively. The largest takes were in July and August around Miscou and the North Shore of the Gulf of St. Lawrence. According to the returned questionnaires, the fish species most usually associated with incidental takes of harbor porpoises include Atlantic cod, herring and mackerel. An at-sea observer program was also conducted during 2001 and 2002. However, due to low observer coverage that was not representative of the fishing effort, Lesage *et al.* (2006) concluded that resulting bycatch estimates were unreliable.

Newfoundland gillnet

This fishery interacts with the Newfoundland harbor porpoise stock, not the Gulf of Maine/Bay of Fundy harbor porpoise stock. Estimates of incidental catch of small cetaceans, where the vast majority are likely harbor porpoises was 862 in 2001, 1,428 in 2002, and 2,228 in 2003 for the Newfoundland nearshore cod and Greenland halibut fisheries, and the Newfoundland offshore fisheries in lumpfish, herring, white hake, monkfish and skate (Benjamins *et al.* 2007).

Table 2. From observer program data, summary of the incidental mortality of Gulf of Maine/Bay of Fundy harbor porpoise (*Phocoena phocoena phocoena*) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
U.S.							
Northeast Sink Gillnet [c, h]	~~04~~05-~~08~~09	Obs. Data, Weighout, Trip Logbook	~~.06,~~ .07, .04, .07, .05, .04	~~27,~~ 51 , 26, 35, 30, 45	~~654,~~ 630 , 514, 395, 666, 591	~~.36,~~ .23, .31, .37, .48, .23	~~572~~559 (0.~~17~~16)
Mid-Atlantic Gillnet	~~04~~05-~~08~~09	Obs. Data Weighout	~~.02,~~ .03, .04, .06, .03, .03	~~2,~~ 15, 20, 1, 9, 7	~~137,~~ 470, 511, 58, 350, 201	~~.91,~~ .51, .32, 1.03, .75, .55	~~305~~318 (0.~~27~~26)
Northeast bottom trawl [g]	~~04~~05-~~08~~09	Obs. Data Weighout	~~.05,~~ .12, .06, .06, .08, .09	~~0,~~ 4, 1, 0, 1, 0	~~0, unk~~7.18, ~~unk~~6.48, ~~0~~5.59, ~~unk~~5.26, 5.10	~~0, unk, unk, 0, unk~~.48, .49, .46, .47, .50	~~unk~~6 (0.22)[~~i~~g]
U.S. TOTAL	~~2004~~2005-~~2008~~2009						~~877~~883 (0.~~15~~14)
CANADA							
Bay of Fundy Sink Gillnet [d,f]	1997-2001	Can. Trips	unk	19, 5, 3, 5, 39	43, 38, 32, 28, 73	unk	43 [f] (unk)
Herring Weir[e]	~~04~~05-~~08~~09	Coop. Data	unk	~~4,~~ 0, 2, 3, 0, 0	~~4,~~ 0, 2, 3, 0, 0	NA	~~1.8~~1.0 (unk)
CANADIAN TOTAL	~~2004~~2005-~~2008~~2009						~~45~~44 (unk)
GRAND TOTAL							~~922~~927~~+~~ (unk)

NA = Not available.

a. Observer data (Obs. Data) are used to measure bycatch rates; the U.S. data are collected by the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program, the Canadian data are collected by DFO. NEFSC collects Weighout (Weighout) landings data that are used as a measure of total effort for the U.S. gillnet fisheries. The Canadian DFO catch and effort statistical system collected the total number of trips fished by the Canadians (Can. Trips), which was the measure of total effort for the Canadian groundfish gillnet fishery. Mandatory vessel trip report (VTR) (Trip Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery. Observed mortalities from herring weirs are collected by a cooperative program between fishermen and Canadian biologists (Coop. Data).

b. Observer coverage for the U.S. Northeast and mid-Atlantic coastal gillnet fisheries, is based on tons of fish landed.

c. During 2002-~~2008~~ 2009 in the Northeast gillnet fishery, harbor porpoises were taken on pingered strings within strata that required pingers but that stratum also had observed strings without pingers. For estimates made during 1998 and after, a weighted bycatch rate was applied to effort from both pingered and non-pingered hauls within a stratum. The weighted bycatch rate was:

$$\sum_{i}^{ping, non-ping} \frac{\# porpoise_i}{sslandings_i} \cdot \frac{\# hauls_i}{total \# hauls}$$

There were 10, 33, 44, 0, 11, 0, 2, 8, 6, 2, 26, 2, 4, 12, 2, 9 ~~and~~, 6 and ~~xx~~11 observed harbor porpoise takes on pinger trips from 1992 to ~~2008~~2009, respectively, that were included in the observed mortality column. In addition, there were 9, 0, 2, 1,1, 4, 0, 1, 7, 21, 33, 24, 7, ~~and~~ 13, and ~~x~~20 observed harbor porpoise takes in 1995 to ~~2008~~2009, respectively, on trips dedicated to fish sampling versus dedicated to watching for marine mammals; these were also included in the observed mortality column (Bisack 1997).

d. There were 255 licenses for herring weirs in the Canadian Bay of Fundy region.

e. ~~There were 22 active weirs around Grand Manan. The number of weirs elsewhere is unknown.~~Data provided by H. Koopman pers. comm.

f. The Canadian gillnet fishery was not observed during 2002 and afterwards, but the fishery is still active; thus, the bycatch estimate is estimated using past averages.

g. Fisheries observer data from the years 2005 through 2009 were pooled and bycatch rates for harbor porpoise were estimated using a stratified ratio-estimator. Estimated bycatch rates from the pooled fisheries

observer data were expanded by annual (2005-2009) fisheries data collected from mandatory vessel trip reports .
Estimates of bycatch mortality attributed to the Northeast bottom trawl fishery have not been generated.
h. Twelve harbor porpoises were incidentally caught as part of a 2009 NEFSC hanging ratio study to examine the impact of gillnet hanging ratio on harbor porpoise bycatch. These animals were included in the observed interactions, and added to the total estimates, though these interactions and their associated fishing effort were not included in bycatch rate calculations.

Table 3. From strandings and entanglement data, summary of confirmed incidental mortality of harbor porpoises (*Phocoena phocoena phocoena*) by fishery: includes years sampled (Years), type of data used (Data Type), mortalities assigned to this fishery (Assigned Mortality), and mean annual mortality.

Fishery	Years	Data Type [a]	Assigned Mortality	Mean Annual Mortality
Unknown gillnet fishery	04-08	Entanglement & Strandings	6, unk[b], unk[b], unk[b], unk[b]	6
TOTAL				6

NA=Not Available.
a Data from records in the entanglement and strandings data base maintained by the New England Aquarium and the Northeast Regional Office/NMFS (Entanglement and Strandings).
b. As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. Thus, the annual mortality is that from 2004.

[B1]**Other Mortality**

U.S.

There is evidence that harbor porpoises were harvested by natives in Maine and Canada before the 1960s, and the meat was used for human consumption, oil, and fish bait (NMFS 1992). The extent of these past harvests is unknown, though it is believed to have been small. Up until the early 1980s, small kills by native hunters (Passamaquoddy Indians) were reported. In recent years it was believed to have nearly stopped (Polacheck 1989) until media reports in September 1997 depicted a Passamaquoddy tribe member dressing out a harbor porpoise. Further articles describing use of porpoise products for food and other purposes were timed to coincide with ongoing legal action in state court.

During 2004, 117 harbor porpoises were reported stranded on Atlantic US beaches. There were 8 reported fishery interactions by state: 1 in Massachusetts (May), 1 in New York (May), and 3 in Virginia (February, March, and April), and 3 in North Carolina (April). In addition, there was 1 mutilation in Delaware during March. Of these 8 fishery interactions, six were in areas and times that were not part of a bycatch estimated derived from the observer data (Table 3).

During 2005, 175 harbor porpoises were reported stranded on Atlantic U.S. beaches. Although 24 animals were classified as having signs of human interaction, and of those 24, 7 showed signs of fishery interaction, in no case was cause of death directly attributable to these interactions. An Unusual Mortality Event was declared for harbor porpoise in North Carolina, as there were 38 stranded in that state between 1 January and 28 March 2005. Most of these were young of the year, and histopathological examinations of 6 of these animals showed no systemic diseases or common symptoms other than emaciation (MMC 2006).

During 2006, 73 harbor porpoises were reported stranded on Atlantic U.S. beaches. Eight of these were reported as having signs of human interaction, but in no case was cause of death directly attributable to these interactions. In fact, in three cases the human interaction was post-mortem. One of the human interaction mortalities was classified as a fishery- interaction (with no further detail), one as a boat collision, and one was involved in an oil spill.

During 2007, 79 harbor porpoises were reported stranded on Atlantic U.S. beaches. Of these, six were reported as having signs of human interaction. One of these was classified as a fishery interaction, and one had signs of propeller wounds, although the marks appeared to have been made post-mortem.

During 2008, 58 harbor porpoises were reported stranded on Atlantic U.S. beaches. Of these, four were reported as having signs of human interaction. One of these was classified as a fishery interaction.

During 2009, 65 harbor porpoises were reported stranded on Atlantic U.S. beaches. Of these, five stranding mortalities were reported as having signs of human interaction, all of which were fishery interactions.

As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human induced mortality estimates. Using only 2004, it is estimated that there were 6 animals per year that were stranded and mutilated and so cause of death was attributed to an unknown human-caused mortality (Table 3).

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Table 4. Harbor Porpoise (*Phocoena phocoena*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2004-2008.

Area	Year					**Total**
	2004	2005	2006	2007	2008	
Maine	15	9	9	10	7	**50**
New Hampshire	2	0	1	0	0	**3**
Massachusetts[a]	49	55	23	22	25	**174**
Rhode Island[b]	3	6	3	1	1	**14**
Connecticut	0	1	0	0	0	**1**
New York[c]	8	15	11	10	3	**47**
New Jersey	14	17	6	5	8	**50**
Pennsylvania	0	1	0	0	0	**1**
Delaware	1	3	3	3	0	**10**
Maryland	2	4	2	0	2	**10**
Virginia	8	22	9	8	6	**53**
North Carolina[d]	15	42	6	20	6	**89**
Florida	0	0	0	0	0	**0**
TOTAL U.S.	**117**	**175**	**73**	**79**	**58**	**502**
Nova Scotia	3	5	4	4	6	**22**
Newfoundland and New Brunswick	0	5	0	1	4	**10**
GRAND TOTAL	**120**	**185**	**77**	**84**	**62**	**534**

a. In Massachusetts, during 2005, 2 animals were relocated and released. In 2006 one stranding record was of an emaciated calf swimming in shallow water, but capture attempts were unsuccessful. One animal was taken to a rehab facility in 2007 and one in 2008.

b. In Rhode Island one animal stranded alive in 2006 and was taken to rehab.

c. Includes one live animal in 2006 in New York.

d. In North Carolina, one animal was relocated and released in 2005, one animal was taken to rehab in 2006, and one animal immediately released in 2008.

Table 3. Harbor Porpoise (*Phocoena phocoena phocoena*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2005-2009.

Area	Year					**Total**
	2005	2006	2007	2008	2009	
Maine	9	9	10	7	4	**39**

New Hampshire	0	1	0	0	0	**1**
Massachusetts[a]	55	23	22	25	19	**144**
Rhode Island[b]	6	3	1	1	1	**12**
Connecticut	1	0	0	0	0	**1**
New York[c]	15	11	10	3	9	**48**
New Jersey[e]	17	6	5	8	4	**40**
Pennsylvania	1	0	0	0	1	**2**
Delaware	3	3	3	0	0	**9**
Maryland	4	2	0	2	5	**13**
Virginia[e]	22	9	8	6	8	**53**
North Carolina[d]	42	6	20	6	14	**88**
Florida	0	0	0	0	0	**0**
TOTAL U.S.	**175**	**73**	**79**	**58**	**65**	**450**
Nova Scotia[f]	5	4	4	6	6	**25**
Newfoundland and New Brunswick[g]	5	0	1	4	2	**12**
GRAND TOTAL	**185**	**77**	**84**	**68**	**73**	**487**

a. In Massachusetts, during 2005, 2 animals were relocated and released. In 2006 one stranding record was of an emaciated calf swimming in shallow water, but capture attempts were unsuccessful. One animal was taken to a rehab facility in 2007 and one in 2008.

b. In Rhode Island one animal stranded alive in 2006 and was taken to rehab.

c. Includes one live animal in 2006 in New York.
d. In North Carolina, one animal was relocated and released in 2005, one animal was taken to rehab in 2006, and one animal immediately released in 2008.
e. In 2009, 3 harbor porpoises were classified as fishery interactions, 2 in VA and 1in NJ.
f. Two of the 2009 animals were released alive.
g. One of the 2009 animals was released alive and the other was entangled dead in a capelin trap mooring.

CANADA

The Nova Scotia Stranding Network documented whales and dolphins stranded between 1991 and 1996 on the coast of Nova Scotia (Hooker *et al.* 1997). Researchers with the Canadian Department of Fisheries and Oceans documented strandings on the beaches of Sable Island during 1970 to 1998 (Lucas and Hooker 2000). Sable Island is approximately 170 km southeast of mainland Nova Scotia. On the mainland of Nova Scotia, a total of 8 stranded harbor porpoises were recorded between 1991 and 1996: 1 in May 1991, 2 in 1993 (July and September), 1 in August 1994 (released alive), 1 in August 1994, and 3 in 1996 (March, April, and July (released alive)). On Sable Island, 8 stranded dead harbor porpoises were documented, most in January and February; 1 in May 1991, 1 in January 1992, 1 in January 1993, 3 in February 1997, 1 in May 1997, and 1 in June 1997. Two strandings during May-June 1997 were neonates (> 80 cm). The harbor porpoises that stranded in the winter (January-February) were on Sable Island, those in the spring (March to June) were in the Bay of Fundy (2 in Minas Basin and 1 near Yarmouth) and on Sable Island (2), and those in the summer (July to September) were scattered along the coast from the Bay of Fundy to Halifax.

Whales and dolphins stranded between 1997 and ~~2008~~ 2009 on the coast of Nova Scotia ~~as~~ were recorded by the Marine Animal Response Society and the Nova Scotia Stranding Network, including ~~are as follows:~~ 3 harbor porpoises stranded in 1997 (1 in April, 1 in June and 1 in July), 2 stranded in June 1998, 1 in March 1999, 3 in 2000 (1 in February, 1 in June, and 1 in August); 2 in 2001 (1 in July and 1 in December), 5 in 2002 (3 in July (1 released alive), 1 in August, and 1 in September (released alive)), 3 in 2003 (2 in May (1 was released alive) and 1 in June (disentangled and released alive)), 4 in 2004 (1 in April, 1 in May, 1 in July (released alive) and 1 in November), 6 in 2005 (1 in April (released alive), 1 in May, 3 in June and 1 in July), 4 in 2006 (1 in June, 1 in August, 1 in

September, and 1 in December), 4 in 2007, 6 in 2008, and 6 in 2009 (2 released alive); Table 3~~4~~).

Five dead stranded harbor porpoises were reported in 2005 by the Newfoundland and Labrador Whale Release and Strandings Program, 1 in 2007 and 4 in 2008, and 2 in 2009 (one dead entangled and one live release) (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009~~,~~; 2010).

USA management measures taken to reduce bycatch

A ruling to reduce harbor porpoise bycatch in U.S.~~A~~ Atlantic gillnets was published in the Federal Register (63 FR 66464) on 02 December 1998 and became effective 01 January 1999. The Gulf of Maine portion of the Harbor Porpoise Take Reduction Plan~~plan~~(HPTRP) pertains to all fishing with sink gillnets and other gillnets capable of catching regulated groundfish in New England waters, from Maine through Rhode Island. This portion of the rule includes time and areas closures, some of which are complete closures; others are closed to gillnet fishing unless pingers are used in the prescribed manner. Also, the rule requires those who intend to fish to attend training and certification sessions on the use of the technology. The mid-Atlantic portion of the plan pertains to waters west of 72º30'W longitude to the mid-Atlantic shoreline from New York to North Carolina. This portion of the rule includes time and area closures, some of which are complete closures; others are closed to gillnet fishing unless the gear meets certain restrictions. The MMPA mandates that the take reduction teams that developed the above take reduction measures periodically meet to evaluate the effectiveness of the plan and modify it as necessary. The Harbor Porpoise Take Reduction Team was reconvened in December 2007 to discuss updated harbor porpoise abundance and bycatch information. The Team recommended modifications to the plan to further reduce harbor porpoise bycatch in commercial fisheries~~.~~. As a result, the HPTRP was amended on 19 February 2010 (75 FR 7383) to expand management areas and seasons in which pingers are required, as well as to increase efforts to monitor and enforce the plan. In addition, the New England portion of the HPTRP now includes consequence closure areas as a management measure strategy. These areas with historically high bycatch rates will close seasonally only if bycatch rates over two consecutive management seasons exceed a specified bycatch rate. This management strategy is intended to reduce harbor porpoise bycatch and to increase compliance with HPTRP regulations. Once triggered, these areas would remain in effect until bycatch levels achieve zero mortality rate goal (ZMRG) or until new management measures are implemented in these areas.

~~NMFS is currently undertaking rule-making to modify the plan.~~

STATUS OF STOCK

The status of harbor porpoises, relative to OSP, in the U.S. Atlantic EEZ is unknown. On 7 January 1993, ~~the National Marine Fisheries Service (~~NMFS~~)~~ proposed listing the Gulf of Maine harbor porpoise as threatened under the Endangered Species Act (NMFS 1993). On 5 January 1999, NMFS determined the proposed listing was not warranted (NMFS 1999). On 2 August 2001, NMFS made available a review of the biological status of the Gulf of Maine/Bay of Fundy harbor porpoise population. The determination was made that listing under the Endangered Species Act (ESA) was not warranted and this stock was removed from the ESA candidate species list (NMFS 2001). Population trends for this species have not been investigated. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because average annual human-related mortality and serious injury exceeds PBR.

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HARBOR SEAL (*Phoca vitulina concolor*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harbor seal is found in all nearshore waters of the North Atlantic and North Pacific Oceans and adjoining seas above about 30ºN (~~Katona *et al*~~Burns~~.~~ ~~1993~~2009). In the western North Atlantic, they are distributed from the eastern Canadian Arctic and Greenland south to southern New England and New York, and occasionally to the Carolinas (Mansfield 1967; Boulva and McLaren 1979; Katona *et al.* 1993; Gilbert and Guldager 1998; Baird 2001). Stanley *et al.* (1996) examined worldwide patterns in harbor seal mitochondrial DNA, which indicate that western and eastern North Atlantic harbor seal populations are highly differentiated. Further, they suggested that harbor seal females are only regionally philopatric, thus population or management units are on the scale of a few hundred kilometers. Although the stock structure of the western North Atlantic population is unknown, it is thought that harbor seals found along the eastern U.S. and Canadian coasts represent one population (Temte *et al.* 1991). In U.S. waters, breeding and pupping normally occur in waters north of the New Hampshire/Maine border, although breeding occurred as far south as Cape Cod in the early part of the twentieth century (Temte *et al.* 1991; Katona *et al.* 1993).

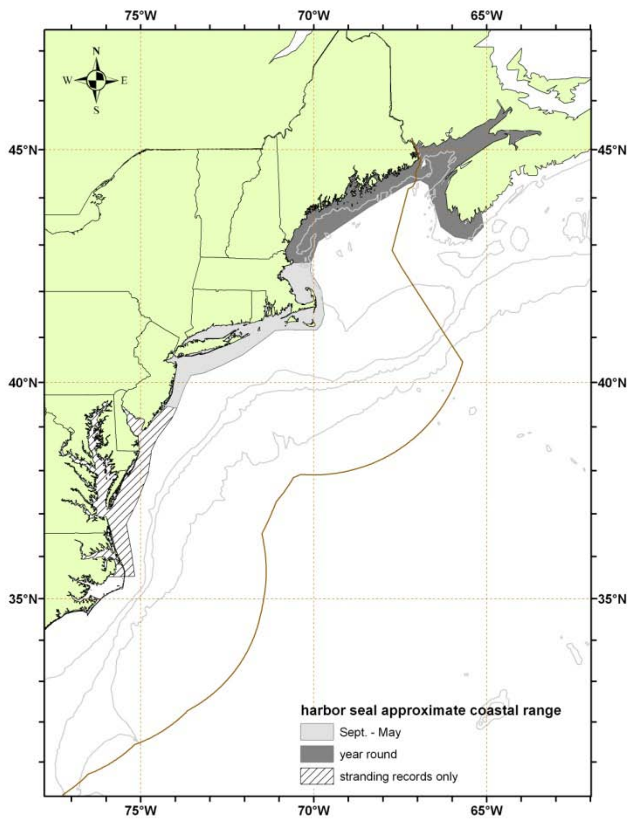

Figure 1. *Approximate coastal range of harbor seals. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.*

Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona et al. 1993), and occur seasonally along the southern New England~~,~~ to New Jersey coasts from September through late May (Schneider and Payne 1983; Barlas 1999; Schroeder 2000; deHart 2002). Scattered sightings and strandings have been recorded as far south as Florida (NMFS unpublished data). A general southward movement from the Bay of Fundy to southern New England waters occurs in autumn and early winter (Rosenfeld *et al.* 1988; Whitman and Payne 1990; Barlas 1999; Jacobs and Terhune 2000). A northward movement from southern New England to Maine and eastern Canada occurs prior to the pupping season, which takes place from mid-May through June along the Maine Coast (Richardson 1976; Wilson 1978; Whitman and Payne 1990; Kenney 1994; deHart 2002). While earlier research identified no pupping areas in southern New England (Payne and Schneider 1984; Barlas 1999), more recent information suggests that some pupping is occurring at high-use haulout sites off Manomet, Massachusetts (B. Rubenstein~~-~~, New England Aquarium, pers. comm.). The overall geographic range throughout coastal New England has not changed significantly during the last century (Payne and Selzer 1989).

Prior to the spring 2001 live-capture and radio-tagging of adult harbor seals, it was believed that the majority of seals moving into southern New England and mid-Atlantic waters were subadults and juveniles (Whitman and Payne 1990; Katona *et al.* 1993). The 2001 study established that adult animals also made this migration. Seventy-five percent (9/12) of the seals tagged in March in Chatham Harbor ~~seals~~ were detected at least once during the May/June 2001 abundance survey along the Maine coast (Gilbert *et al.* 2005; Waring *et al.* 2006).

HABITAT

As elsewhere, harbour seals use a variety of terrestrial and aquatic habitats in U.S. waters, and their activities are influenced by regional topography, life history requirements, environmental parameters, anthropogenic activities, prey distribution, and perhaps inter-specific competition with grey seals (*Halichoerus grypus*) (Richardson 1976, Gilbert and Stein 1981, Schneider and Payne 1983, Thompson 1989, Payne and Selzer 1989, Barlas 1999, Lucas and Stobo 2000, Schroeder 2000, deHart 2002, Bjørge *et al.* 2002b, Bowen *et al.* 2003, Renner 2005, Robillard *et al.* 2005, Hammill *et al.* this volume). Rocky areas (i.e., small islands, isolated rocks, tidal ledges) are the predominant haul-out substrate in coastal waters from the Maine – Canadian border south to Plymouth, Massachusetts (Richardson 1976, Schneider and Payne 1983, Harris *et al.* 2003, Gilbert *et al.* 2005, Renner 2005). Rocky substrates are also used during the pupping, breeding and moulting seasons when harbour seals are concentrated in Maine coastal waters (Richardson 1976, Katona *et al.* 1993, Guldager 2001, Gilbert *et al.* 2005). Between Cape Cod and New Jersey (most southern notable haul out sites), the coastal geology is more variable and seals utilize a wider variety of substrates (i.e., tidally exposed sand and gravel bars, sand-peat hummock in tidal marshes, sandy beaches and islands, rock outcroppings and stone jetties) (Schneider and Payne 1983, Payne and Selzer 1989, Barlas 1999, Schroeder 2000, deHart 2002). Further, storm events alter the characteristics of or access to “sandy” haul out sites, particularly around the outer portion of Cape Cod and eastern Nantucket Sound. Both harbour and grey seals readily acclimate to newly formed haul out sites (i.e., barrier beach breaks, re-emerged sand bars), thus giving the appearance of a “sudden influx” or “population growth” of seal populations in Cape Cod waters.

Seals haul-out on near-shore ice (Katona *et al.* 1993), and small groups have been observed on ice floes around Cape Cod in winter when conditions restrict access to traditional (i.e., sandy beach) haul out sites (John Prescott, pers. comm., Massachusetts Audubon Society, Wellfleet, Massachusetts).

POPULATION SIZE

Since passage of the MMPA in 1972, the observed count of seals along the New England coast has been increasing. Coast-wide aerial surveys along the Maine coast were conducted in May/June 1981, 1986, 1993, 1997, and 2001 during pupping (Gilbert and Stein 1981; Gilbert and Wynne 1983,; 1984; Kenney 1994; Gilbert and Guldager 1998; Gilbert *et al.* 2005). However, estimates older than eight years are deemed unreliable (Wade and Angliss 1997), and should not be used for PBR determinations. Therefore, there is no current abundance estimate for harbor seals. The 2001 survey, conducted in May/June, included replicate surveys and radio tagged seals to obtain a correction factor for animals not hauled out. The corrected estimate (pups in parenthesis) for 2001 is was 99,340 (23,722). The 2001 observed count of 38,014 is 28.7% greater than the 1997 count. Increased abundance of seals in the Northeast region has also been documented during aerial and boat surveys of overwintering haul-out sites from the Maine/New Hampshire border to eastern Long Island and New Jersey (Payne and Selzer 1989; Rough 1995; Barlas 1999; Schroeder 2000; deHart 2002).

Canadian scientists counted 3,500 harbor seals during an August 1992 aerial survey in the Bay of Fundy (Stobo and Fowler 1994), but noted that the survey was not designed to obtain a population estimate. The Sable Island population was the largest in eastern Canada in the late 1980s, however recently the number has drastically declined (Baird 2001). Similarly, pup production declined on Sable Island from 600 in 1989 to around a dozen pups or fewer by 2002 (Baird 2001; Bowen *et al.* 2003). A decline in the number of juveniles and adults did not occur immediately, but a decline was observed in these age classes as a result of the reduced number of pups recruitmoving into the older age classes (Bowen et al. 2003). Possible reasons for this decline may be increased use of the island by gray seals and increased predation by sharks (Stobo and Lucas 2000; Bowen *et al.* 2003). Helicopter surveys have also been flown to count hauled-out animals along the coast and around small islands in parts of the Gulf of St. Lawrence and the St. Lawrence estuary. In the estuary, surveys were flown in June 1995, 1996, and 1997, and in August 1994, 1995, 1996, and 1997; different portions of the Gulf were surveyed in June 1996 and 2001 (Robillard *et al.* 2005). Changes in counts over time in sectors that were flown under similar conditions were examined at nine sites that were surveyed in June and in August. Although all slopes were positive, only one was significant, indicating numbers are likely stable or increasing slowly. Overall, the June surveys resulted in an average of 469 (SD=60, N=3) hauled-out animals, which is lower than the averagea count of 621 (SD=41, N=3) hauled-out animals flown under similar conditions in August. Aerial surveys in the Gulf of St. Lawrence resulted in counts of 467 animals in 1996 and 423 animals in 2001 for a different area (Robillard et al. 2005).

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate for this stock.

Current Population Trend

There are insufficient data to determine the population trends for this stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this population. Based on uncorrected haul-out counts over the 1981 to 2001 survey period, the harbor seal population was growing at approximately 6.6% (Gilbert et al. 2005). However, a population grows at the maximum growth rate (R_{max}) only when it is at a very low level; thus the 6.6% growth rate is not considered to be a reliable estimate of ~~(~~R_{max}~~)~~. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate (½ of 12%), and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The recovery factor (F_R) for this stock is 0.5, the value for stocks of unknown status. PBR for the western North Atlantic stock of harbor seals is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY

For the period ~~2004-2008~~2005-2009 the total human caused mortality and serious injury to harbor seals is estimated to be ~~434~~~~xxx~~385 per year. The average was derived from two components: 1) ~~425 (CV=0.16)~~~~xxx~~377 (CV=0.13; Table 2) from the ~~2004-2008~~2005-2009 observed fishery; and 2) ~~9.4~~ ~~xxx~~8 from average ~~2004-2008~~2005-2009 non-~~fishery~~ fishery-related, human interaction stranding mortalities (NMFS unpublished data).

Researchers and fishery observers have documented incidental mortality in several fisheries, particularly within the Gulf of Maine (see below). An unknown level of mortality also occurred in the mariculture industry (i.e., salmon farming), and by deliberate shooting (NMFS unpublished data). Between ~~2004~~ 2005 and ~~2008~~2009, there are ~~6~~~~x~~7 records of harbors seals and ~~3~~~~X~~3 of unidentified seals with evidence of gunshot wounds in the Northeast Regional Office Marine Mammal Stranding Network database.

Fishery Information

Detailed ~~Fishery~~ fishery information is given in Appendix III.

U.S.

Northeast Sink Gillnet:

Annual estimates of harbor seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. The fishery has been observed in the Gulf of Maine and in southern New England (Williams 1999; NMFS unpublished data). There were ~~560~~~~xxx~~~~562~~581 harbor seal mortalities observed in the Northeast sink gillnet fishery between 1990 and ~~2008~~2009, excluding three animals taken in the 1994 pinger experiment (NMFS unpublished data). Williams (1999) aged 261 harbor seals caught in this fishery from 1991 to 1997, and 93% were juveniles (~~e.g~~i.e.. less than four years old). Estimated annual mortalities (CV in parentheses) from this fishery were 332 (0.33) in 1998, 1,446 (0.34) in 1999, 917 (0.43) in 2000, 1,471 (0.38) in 2001, 787 (0.32) in 2002, 542 (0.28) in 2003, 792 (0.34) in 2004, 719 (0.20) in 2005, 87 (0.58) in 2006, 92 in 2007, ~~and~~ 243 (0.41) in 2008, and ~~xxx~~516 (0.28) in 2009 (Table 2). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). There were 2, 9, 14, 8, 14, ~~and~~ 6, and ~~??~~8 unidentified seals observed during ~~2003-2008~~2003-2009, respectively. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during ~~2004-2008~~2005-2009 was ~~387~~~~xxx~~ 332 harbor seals (CV=~~0.17~~~~xxx~~0.14~~)~~ ~~(~~; Table 2).

Mid-Atlantic Gillnet

No harbor seals were taken in observed trips during 1993-1997, or 1999-2003. Two harbor seals were observed taken in 1998, ~~one~~ 1 in 2004, ~~two~~ 2 in 2005, ~~one~~ 1 in 2006, ~~none~~ 0 in 2007, ~~and two~~2 in 2008, and ~~xxx~~2~~1~~2 in 2009. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 0 in 1995-1997 and 1999-2003, 11 in 1998 (0.77), 15 (0.86) in 2004, 63 (0.67) in 2005, 26 (0.98) in 2006, 0 in 2007, ~~and~~ 88 (0.74) in 2008, and ~~xxx~~47 (0.68) in 2009. ~~-~~Average annual estimated fishery-related mortality attributable to this fishery during ~~2004-2008~~2005-2009 was ~~38xx~~45 (CV = ~~0.43xx~~0.39) harbor seals (Table 2).

Northeast Bottom Trawl

Seven harbor seal mortalities were observed between 2001 and 2007, ~~one~~ 1 in 2002, ~~one~~ 1 in 2005, ~~three~~ 3 in 2007, ~~and none~~0 in 2008, and 1 in 2009~~???~~. (Table 2). The estimated annual fishery-related mortality and serious injury attributable to this fishery has not been generated.

Gulf of Maine Atlantic Herring Purse Seine Fishery

The Gulf of Maine Atlantic Herring Purse Seine Fishery is a Category III fishery. This fishery was not observed until 2003. No mortalities have been observed, but 11 harbor seals were captured and released alive in 2004 and 4 in 2005. In addition, 5 seals of unknown species were captured and released alive in 2004, 2 in 2005, ~~one~~ 1 in 2007, ~~and one~~ 1 in 2008~~???~~ and none in 2009. This fishery was not observed in 2006.

CANADA

Currently, scant data are available on bycatch in Atlantic Canada fisheries due to a lack of observer programs (Baird 2001). An unknown number of harbor seals have been taken in Newfoundland, Labrador, Gulf of St. Lawrence and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy herring weirs (Read 1994; Cairns *et al.* 2000). Furthermore, some of these mortalities (e.g., seals trapped in herring weirs) are the result of direct shooting.

Table 2. Summary of the incidental mortality of harbor seals (*Phoca vitulina concolor*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet [c]	~~04~~05-~~08~~09	Obs. Data, Weighout, Logbooks	~~.06,~~ .07, .04, .07, .05, .04	~~45,~~ 70, 3, 6, 9, 21	~~792,~~ 719, 87, 93, 243, 516	~~.34,~~ .20, .58, .49, .41, .28	~~387~~ 332(0.~~17~~14)
Mid-Atlantic Gillnet	~~04~~05-~~08~~ 09	Obs. Data, Weighout	~~.02,~~ .03, .04, .06, .03, .03	~~1,~~ 2, 1, 0, 2, 2~~1~~	~~15,~~ 63, 26, 0, 88, 47	~~.86,~~ .67, .98, 0, .74, .68	~~38~~ 45 (0.~~43~~39)
Northeast Bottom Trawl	~~04~~05-~~08~~ 09	Obs. Data, Weighout	~~.05,~~ .12, .06, .05, .08, .09	~~0,~~ 1, 0, 3, 0, 1	~~0,~~ unk[d], 0, unk[d], 0, unk[d]	~~0,~~ unk[d], 0, unk[d], 0, unk[d]	unk[d]
Northeast Mid-water Trawl - Including Pair Trawl	05-09	Obs. Data Weighout Trip Logbook	.199, .031, .08, .199, .42	0, 0, 0, 0, 1	0, 0, 0, 0, 1,3	0, 0, 0, 0, .81	0.3 (0.81)

TOTAL		~~425~~377 (0.~~16~~??13)

[a] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. NEFSC collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery.

[b] The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed and coverages for the northeast bottom trawl are ratios based on trips.

[c] Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In ~~2004~~ 2005 - ~~2008~~2009, respectively, ~~8,~~ 3, 3, 2, ~~and~~ 0 and ??8 takes were observed in nets with pingers. In ~~2004~~ 2005 – ~~2008~~2009, respectively, ~~37,~~ 67, 0, 4, ~~and~~ 9 and ??13 takes were observed in nets without pingers.

[d] Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery for the years ~~2004~~2005-~~2008~~ 2009 has not been generated.

Other Mortality

Canada: Aquaculture operations in eastern Canada are licensed to shoot nuisance seals, but the number of seals killed is unknown (Jacobs and Terhune 2000; Baird 2001). ~~-~~Small numbers of harbor seals are taken in subsistence hunting in northern Canada, and Canada also issues personal hunting licenses which allow the holder to take six seals annually (DFO 2008).

U.S.: Historically, harbor seals were ~~bounty~~ bounty-hunted in New England waters, which may have caused a severe decline of this stock in U.S. waters (Katona et al. 1993; Lelli *et al*., 2009). ~~Bounty~~ Bounty-hunting ended in the mid-1960s.

Other sources of harbor seal mortality include human interactions, storms, abandonment by the mother, disease, and predation (Katona *et al.* 1993; NMFS unpublished data; Jacobs and Terhune 2000). Mortalities caused by human interactions include boat strikes, fishing gear interactions, oil spill/exposure, harassment, and shooting.

Small numbers of harbor seals strand each year throughout their migratory range. Stranding data provide insight into some of these sources of mortality. From ~~2004 to 2008, 1,823~~2005- to 2009, ~~xxx~~1,477 harbor seal stranding mortalities were reported ~~in all states~~ between Maine and Florida (Table 3; NMFS unpublished data). ~~Sixty-eight (3.7%) xxx~~Fifty-nine (4%) of the seals stranded during this ~~five~~ five-year period showed signs of human interaction (~~15 in 2004,~~ 14 in 2005, 8 in 2006, 21 in 2007, ~~and~~ 10 in 2008, and ~~xxx~~6 in 2009), with ~~21xx~~ 18 having some sign of fishery interaction ~~3 in 2004,~~ (0 in 2005, 8 in 2006, 5 in 2007, ~~and~~ 5 in 2008, and ~~xxx~~0 in 2009). An Unusual Mortality Event (UME) was declared for harbor seals in northern Gulf of Maine waters in 2003 and continued into 2004. No consistent cause of death could be determined. ~~-~~The UME was declared over in spring 2005 (MMC ~~[Marine Mammal Commission]~~ 2006). NMFS declared another UME in the Gulf of Maine in autumn 2006 based on infectious disease.

Stobo and Lucas (2000) have documented shark predation as an important source of natural mortality at Sable Island, Nova Scotia. They suggest that shark-inflicted mortality in pups, as a proportion of total production, was less than 10% in 1980-1993, approximately 25% in 1994-1995, and increased to 45% in 1996. Also, shark predation on adults was selective towards mature females. The decline in the Sable Island population appears to result from a combination of shark-inflicted mortality~~,~~ on both pups and adult females and inter-specific competition with the much more abundant gray seal for food resources (Stobo and Lucas 2000; Bowen *et al.* 2003).

~~Table 3. Harbor seal (*Phoca vitulina concolor*) stranding mortalities along the U.S. Atlantic coast (2004-2008) with subtotals of animals recorded as pups in parentheses.[a].~~

~~State~~	~~2004[b]~~	~~2005~~	~~2006[b]~~	~~2007[b]~~	~~2008~~	~~Total~~
~~ME~~	~~348~~	~~121(94)~~	~~371 (220)~~	~~106 (80)~~	~~178 (152)~~	~~1124~~
~~NH~~	~~21~~	~~31 (25)~~	~~28 (19)~~	~~6 (5)~~	~~3 (2)~~	~~89~~
~~MA~~	~~150~~	~~101(45)~~	~~94 (35)~~	~~51 (17)~~	~~50 (4)~~	~~446~~
~~RI~~	~~11~~	~~3~~	~~6 (3)~~	~~8 (1)~~	~~6 (4)~~	~~34~~
~~CT~~	~~1~~	~~2 (1)~~	~~1 (1)~~	~~3~~	~~-~~	~~7~~
~~NY~~	~~12~~	~~22 (2)~~	~~11~~	~~11 (7)~~	~~5 (1)~~	~~61~~
~~NJ~~	~~5~~	~~1 (1)~~	~~7~~	~~6~~	~~7~~	~~26~~

DE	-	3 (1)	2	-	-	5
MD	-	2	-	-	-	2
VA	2	3	2	-	1	8
NC	2	8 (3)	4	-	6 (2)	20
FL	-	-	1	-	-	1
Total	552	297	527	191	256	1823
Unspecified seals (all states)	33	59	46	34	51	223

a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Records of live releases and rehabbed animals have been eliminated. Mortalities include animals found dead and animals that were euthanized, died during handling, or died in the transfer to, or upon arrival at, rehab facilities.

b. Unusual Mortality Event (UME) declared for harbor seals in northern Gulf of Maine waters during 2003-2004, and again in 2006-2007.

Table 3. Harbor seal (*Phoca vitulina concolor*) stranding mortalities along the U.S. Atlantic coast (2005-2009) with subtotals of animals recorded as pups in parentheses[a].

State	2005	2006[b]	2007[b]	2008	2009	Total
ME	121(94)	371 (220)	106 (80)	178 (152)	76	852
NH	31 (25)	28 (19)	6 (5)	3 (2)	15	83
MA	101(45)	94 (35)	51 (17)	50 (4)	74	370
RI	3	6 (3)	8 (1)	6 (4)	5 (2)	28
CT	2 (1)	1 (1)	3	-	-	6
NY	22 (2)	11	11 (7)	5 (1)	14	63
NJ	1 (1)	7	6	7	11	32
DE	3 (1)	2	-	-	-	5
MD	2	-	-	-	2	4
VA	3	2	-	1	3	9
NC	8 (3)	4	-	6 (2)	6 (5)	24
FL	-	1	-	-	-	1
Total	297	527	191	256	206	1477
Unspecified seals (all states)	59	46	34	51	34	224

a. Some of the data reported in this table differ from thatose reported in previous years. We have reviewed the records and made an effort to standardize reporting. Records of live releases and rehabbed animals have been eliminated. -Mortalities include animals found dead and animals that were euthanized, died during handling, or died in the transfer to, or upon arrival at, rehab facilities.

b. Unusual Mortality Event (UME) declared for harbor seals in northern Gulf of Maine waters during 2006-2007.

STATUS OF STOCK

The status of the western North Atlantic harbor seal stock, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. Total fishery-related mortality and serious injury for this stock is believed to be low relative to the population size in U.S. waters but cannot be considered to be approaching zero mortality and serious injury rate. Although PBR cannot be determined for this stock, the level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is believed to be low relative to the total stock size; therefore, this is not a strategic stock.

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GRAY SEAL (*Halichoerus grypus grypus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray seal is found on both sides of the North Atlantic, with three major populations: eastern Canada, northwestern Europe and the Baltic Sea (Katona *et al.* 1993). The western North Atlantic stock is equivalent to the eastern Canada population, and ranges from New York to Labrador (Davies 1957; Mansfield 1966; Katona *et al.* 1993; Lesage and Hammill 2001). This stock is separated by geography, differences in the breeding season, and mitochondrial DNA variation from the northeastern Atlantic stock (Bonner 1981; Boskovic *et al.* 1996; Lesage and Hammill 2001). There are two breeding concentrations in eastern Canada; one at Sable Island, and one that breeds on the pack ice in the Gulf of St. Lawrence (Laviguer and Hammill 1993). Tagging studies indicate that there is little intermixing between the two breeding groups (Zwanenberg and Bowen 1990) and, for management purposes, they are treated by the Canadian DFO as separate stocks (Mohn and Bowen 1996). In the mid- 1980s, small numbers of animals and pupping were observed on several isolated islands along the Maine coast and in Nantucket-Vineyard Sound, Massachusetts (Katona *et al.* 1993; Rough 1995: J. R. Gilbert, pers. comm., University of Maine, Orono, ME~~;~~ ~~Rough 1995~~). In the late 1990'~~'~~s, a year-round breeding population of approximately 400+ animals was documented on outer Cape Cod and Muskeget Island (D. Murley, pers. comm., Mass. Audubon Society, Wellfleet, MA). In December 2001, NMFS initiated aerial surveys to monitor gray seal pup production on Muskeget Island and adjacent sites in Nantucket Sound, and Green and Seal Islands off the coast of Maine (Wood *et al.* 2007).

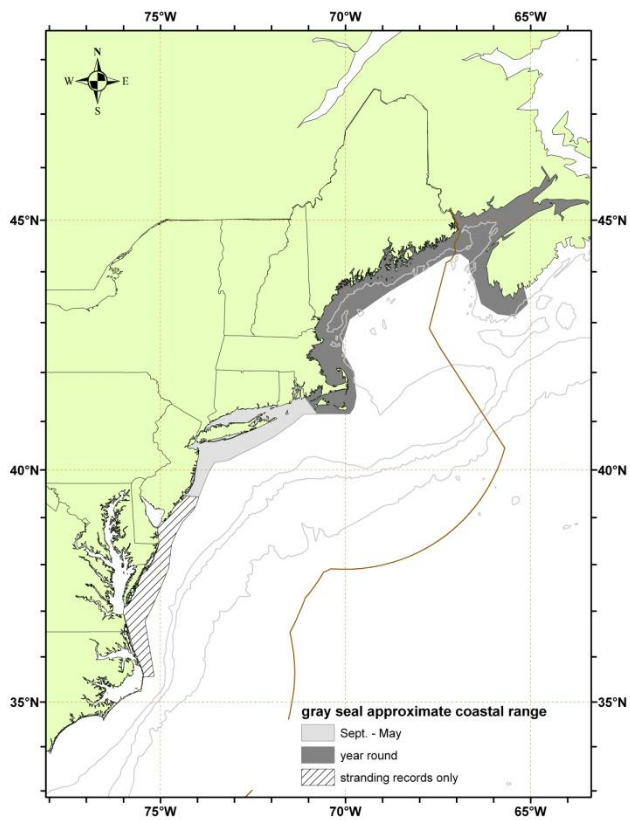

Figure 1. Approximate coastal range of gray seals. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.

POPULATION SIZE

Current estimates of the total western Atlantic gray seal population are not available; although estimates of portions of the stock are available for select time periods. The size of the Canadian population from 1993 to 2004 has been estimated from three surveys. A 1993 survey estimated the population at 144,000 animals (Mohn and Bowen 1996; DFO 2003) a 1997 survey estimated 195,000 (DFO 2003), and a 2004 survey obtained estimates ranging between 208,720 (SE=29,730) and 223,220 (SE=17,376) depending upon the model used (Trzcinski *et al.* 2005). The population at Sable Island had been increasing by approximately 13% per year for nearly 40 years (Bowen *et al.* 2003), but the most recent (2004) survey results indicated that this rate of population increase ~~has~~ had declined to 7% (Trzcinski *et al.* 2005; Bowen *et al.* 2007). The non-Sable Island (Gulf of St Lawrence and Eastern Shore) abundance has increased from 20,900 (SE=200) in 1970 to 52,500 (SE=7,800) in 2004 (Hammill 2005).

In U.S. waters, gray seals currently pup at three established colonies: Muskeget Island, ~~MA~~Massachusetts, Green Island, ~~ME~~Maine, and Seal Island, ~~ME~~Maine, as well as, more recently, at Matinicus Rock in Maine. They have been observed using the historic pupping site on Muskeget Island in Massachusetts since 1990. Pupping has taken place on Seal and Green Islands in Maine since at least the mid 1990's. Aerial survey data ~~of~~ from these sites indicate that pup production is increasing. A minimum of 2,620 pups (Muskeget= 2,095, Green= 59, Seal= 466) was born in the U.S. in 2008 (Wood LaFond 2009). ~~-~~Table 2 summarizes ~~singe~~ single-day pup counts from the three U.S. pupping colonies from 2001/2002 to 2007/2008 pupping periods. ~~-~~The decrease in pup counts in some years is an artifact of survey ~~date~~ timing and not indicative of true declines in those years. ~~-~~In recent years NMFS monitoring surveys have detected an occasional mother/pup (white coats) pair on both Monomoy Island ~~(MA)~~ and Noman's Land in Massachusetts. ~~(MA).~~ Some of the local breeders have been observed with brands and tags indicating they had been born on Sable Island, Canada (Rough 1995). ~~-~~The increase in the number of gray seals observed in the U.S. is probably due to both natural increase and immigration.

Gray seals are also observed in New England outside of the pupping season. ~~-~~In April-May 1994 a maximum count of 2,010 was obtained for Muskeget Island and Monomoy combined (Rough 1995). ~~–~~Maine coast-wide surveys conducted during summer revealed 597 and 1,731 gray seals in 1993 and 2001, respectively (Gilbert *et al.* 2005). ~~—~~In March 1999 a maximum count of 5,611 was obtained in the region south of Maine (between Isles of Shoals, Maine and Woods Hole, Massachusetts) (Barlas 1999). No gray seals were recorded at ~~haul~~ haul-out sites between Newport, Rhode Island and Montauk Pt., New York (Barlas 1999), although, more recently several hundred gray seals have been recorded in surveys conducted off eastern Long Island (R. DiGiovanni, pers. comm., The Riverhead Foundation, Riverhead, NY).

Table 1. Summary of abundance estimates for the western North Atlantic gray seal~~.~~: ~~Month~~month, year, and area covered during each abundance survey, resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	**Area**	**Nbest**	**CV**
January 2004[a]	Gulf of St Lawrence + Nova Scotia Eastern Shore	52,500	0.15
January 2004[a]	Sable Island	208,720 216,490 223,220	0.14 0.11 0.08

[a]These are model based estimates derived from pup surveys.

Table 2. The number of pups observed on Muskeget, Seal, and Green Islands 2002-2008. ~~-~~Data are from aerial surveys. ~~-~~These are ~~single~~ single-day counts, not ~~an~~ estimates of total pup production. (Wood LaFond 2009).

Pupping Season	Muskeget Island	Seal Island	Green Island
2001-2	883	No data	34
2002-3	509	147	No data
2003-4	824	150	26
2004-5	992	365	33
2005-6	868	239	43
2006-7	1704	364	57
2007-8	2095	466	59

Minimum Population Estimate

Depending on the model used, the N_{min} for the Canadian gray seal population was estimated to range between 125,541 and 169,064 (Trzcinski et al. 2005) Present data are insufficient to calculate the minimum population estimate for U.S. waters.

Current Population Trend

Gray seal abundance is likely increasing in the U.S. Atlantic Exclusive Economic Zone (EEZ), but the rate of increase is unknown. The population in eastern Canada was greatly reduced by hunting and bounty programs, and in the 1950s the gray seal was considered rare (Lesage and Hammill 2001). The Sable Island population was less affected and has been increasing for several decades. Pup production on Sable Island, Nova Scotia, has increased exponentially at a rate of 12.8% annually for more than 40 years (Stobo and Zwanenburg 1990; Mohn and Bowen 1996; Bowen *et al.* 2003; Trzcinski *et al.* 2005; Bowen *et al.* 2007), but has declined to 7% in 2004 (Trzcinski *et al.* 2005; Bowen *et al.* 2007). The non Sable Island population increased from 6,900 in the mid-1980s to a peak of 11,100 (SE=1,300) animals in 1996 (Hammill and Gosselin 2005). Pup production declined to 6,100 (SE=900) in

2000, then increased to 15,900 (SE=1,200) in 2004 (Hammill and Gosselin 2005). Approximately 57% of the western North Atlantic population is from the Sable Island stock. In recent years pupping has been established on Hay Island, off the Cape Breton coast (Lesage and Hammill 2001).

Surveys of winter breeding colonies in Maine and on Muskeget Island may provide some measure of gray seal population trends and expansion in distribution. Sightings in New England increased during the 1980's as the gray seal population and range expanded in eastern Canada. Five pups were born at Muskeget in 1988. The number of pups increased to 12 in 1992, 30 in 1993, and 59 in 1994 (Rough 1995). In January 2002, 883 pups were counted on Muskeget Island and surrounding shoals (Wood Lafond 2009). In recent years NMFS monitoring surveys have detected an occasional mother/pup (white coats) pair on both Monomoy Island and Nomans Land. These observations continue the increasing trend in pup production reported by Rough (1995). The change in gray seal counts at Muskeget and Monomoy from 2,010 in spring 1994 to 5,611 in spring 1999 represents an annual increase rate of 20.5%, however, it has not been determined what proportion of the increase represents growth or immigration. For example, a few gray seals branded as pups on Sable Island in the 1970s (Stobo and Zwanenburg 1990) are typically sighted in the Cape Cod region during winter.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. A recent study estimated the current annual rate of increase at 7% on Sable Island (Trzcinski *et al.* 2005; Bowen *et al.* 2007), which represents a 45% decline from previous estimates (Mohn and Bowen 1996; Bowen *et al.* 2003). For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor (F_R) for this stock is 1.0, the value for stocks of unknown status, but which are~~is~~ known to be increasing. PBR for the western North Atlantic gray seals in U.S. waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2005-2009, the total estimated human caused mortality and serious injury to gray seals was ~~1,135~~ 1,682 per year. The average was derived from three components: 1) ~~581 (0.15)~~ ~~xxx~~678 (Table 3) from the ~~2004-2008~~2005-2009 U.S. observed fishery; 2) ~~4.8~~ ~~xxx~~5 from average ~~2004-2008~~2005-2009 non-fishery related, human interaction stranding mortalities (NMFS unpublished data); and 3) ~~549~~ 999 from average ~~2004-2008~~2005-2009 kill in the Canadian hunt.

Fishery Information

Detailed fishery information is given in Appendix III.

U.S.

Northeast Sink Gillnet

Annual estimates of gray seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. There were ~~216~~~~xxx~~268 gray seal mortalities observed in the Northeast sink gillnet fishery between 1993 and ~~2008~~2009. Estimated annual mortalities (CV in parentheses) from this fishery were 0 in 1990-1992, 18 in 1993 (1.00), 19 in 1994 (0.95), 117 in 1995 (0.42), 49 in 1996 (0.49), 131 in 1997 (0.50), 61 in 1998 (0.98), 155 in 1999 (0.51), 193 in 2000 (0.55), 117 in 2001 (0.59), 0 in 2002, 242 (0.47) in 2003, 504 (0.34) in 2004, 574 (0.44) in 2005, 314 (0.22) in 2006, 886 (0.24) in 2007, ~~and~~ 618 (0.23) in 2008 and ~~xxx~~1,063 in 2009 (Table 3). There were 2, 9, 14, 8, 14, ~~and~~ 6, and 8 - unidentified seals observed during 2003-~~2008~~2009, respectively. Since 1997 unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during ~~2004-2008~~2005-2009 was ~~567~~~~xxx~~678 gray seals (CV= ~~0.15~~~~xxx~~0.14) (Table 3). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996).

~~Mid-Atlantic Coastal Gillnet~~

~~No gray seals were taken in observed trips during 1998-2000, 2003, or 2006-2008???. One gray seal was observed taken in both 2001and 2004 (Table 3). In 2001 the gray seal was taken in April off the coast of New Jersey near Hudson Canyon in 81 m of water. The 2004 take was off Virginia in April. Observed effort was scattered between New Jersey and North Carolina from 1 to 90 km off the beach. In 2002, 65% of sampling was concentrated in one area and not distributed proportionally across the fishery. Therefore, observed mortality is considered unknown in 2002. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 2004-20082005-2009 was 14 gray seals (CV= 0.92) (Table 3).~~

Gulf of Maine Atlantic Herring Purse Seine Fishery

The Gulf of Maine Atlantic Herring Purse Seine Fishery is a Category III fishery. This fishery was not observed until 2003, and was not observed in 2006. No mortalities have been observed, but 15 gray seals were captured and released alive in 2004, 19 in 2005, 0 in 2007, ~~and~~ 6 in 2008, and ~~xxx~~0 in 2009. In addition, 5 seals of unknown species were captured and released alive in 2004, 2 in 2005, 1 in 2007, and none in 2008 ~~???~~or 2009.

Northeast Bottom Trawl

Vessels in the North Atlantic bottom trawl fishery, a Category III fishery under MMPA, were observed in order to meet fishery management, rather than marine mammal management needs. No mortalities were observed prior to 2005, when four mortalities were attributed to this fishery. No mortalities were observed in 2006. The estimated annual fishery-related mortality and serious injury attributable to this fishery was 0 between 2001 and 2004, and for 2006. Nine gray seal mortalities were attributed to this fishery in 2007, ~~and~~ 4 in 2008 and 8 in 2009 ~~???~~. Estimates have not been generated ~~for 2005, 2007 or 2008 ???~~.

CANADA

An unknown number of gray seals have been taken in Newfoundland and Labrador, Gulf of St. Lawrence, and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy herring weirs (Read 1994). In addition to incidental catches, some mortalities (e.g., seals trapped in herring weirs) were the result of direct shooting, and there were culls of about 1,700 animals annually during the 1970s and early 1980s on Sable Island (Anonymous 1986).

In 1996, observers recorded 3 gray seals (1 released alive) in Spanish deep-water trawl fishing on the southern edge of the Grand Banks (NAFO Areas 3) (Lens 1997). Seal bycatch occurred year-round, but interactions were highest during April-June. Many of the seals that died during fishing activities were unidentified. The proportion of sets with mortality (all seals) was 2.7 per 1,000 hauls (0.003).

Table 3. Summary of the incidental mortality of gray seal (*Halichoerus grypus grypus*) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet [c]	~~04~~05-~~08~~09	Obs. Data, Weighout, Logbooks	~~.06,~~ .07, .04, .07, .05, .04	~~21,~~ 33, 9, 80, 31, 52	~~504,~~ 574, 248, 886, 618, 1063	~~.34,~~ .44, .47, .24, .23, .26	~~567~~ 678 (0.~~15~~14)
~~Mid-Atlantic Gillnet~~	~~04-08~~	~~Obs. Data, Weighout~~	~~.02, .03, .04, .05, .03~~	~~1, 0, 0, 0, 0~~	~~69, 0, 0, 0, 0~~	~~.92, 0, 0, 0, 0~~	~~14 (0.92)~~
Northeast Bottom Trawl	~~04~~0~~9~~5-~~08~~09	Obs. Data, Weighout	~~.05,~~ .12, .06, .06, .08, .09	~~0,~~ 4, 0, 9, 4, 8	~~0, 0,~~ unk[d] ~~,~~, 0, unk[d] -, unk[d], unk[d]	~~0, 0,~~ unk[d] ~~,~~, 0, unk[d], unk[d]-, unk[d]	unk[d]

TOTAL		~~581~~678 (0.~~15~~14)

a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. The Northeast Fisheries Observer Program collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast multispecies sink gillnet fishery.

b. The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed.

c. Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In ~~2004~~ 2005- ~~2008~~2009, respectively, ~~1,~~ 1, 1 8, ~~and~~ 4and ~~??~~13 takes were observed in nets with pingers. In ~~2004~~ 2005 – ~~2008~~2009, respectively, ~~4,~~ 20, 32, 8, 72, ~~and~~ 27 and ~~??~~39 takes were observed in nets without pingers.

d. Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery has not been generated.

Other Mortality

Canada: In Canada, gray seals were hunted for several centuries by indigenous people and European settlers in the Gulf of St. Lawrence and along the Nova Scotia eastern shore, and were locally extirpated (Laviguer and Hammill 1993). Between 1999 and ~~2008~~ 2009 the annual kill of gray seals by hunters in Canada was: 1999 (98), 2000 (342), 2001 (76), 2002 (126), 2003 (6), 2004 (0), 2005 (579), 2006 (1,804) 2007 (887), 2008 (1,472), and 2009 (254)~~9 (2009)~~. (DFO 2003; 2008; 2009; M. Hammill pers. comm.). The traditional hunt of a few hundred animals is expected to continue off the Magdalen Islands and in other areas, except Sable Island where commercial hunting is not permitted (DFO 2003). DFO established a ~~2008~~ total allowable catch (TAC) of 12,000 gray seals for 2007 and 2008: 2,000 in the Gulf and 10,000 on the Scotian Shelf. The TAC for 2009 and 2010 was 50,000 seals. Since 2007, a small commercial hunt has taken place on Hay Island in Nova Scotia (http://www.dfo-mpo.gc.ca/fm-gp/seal-phoque/faq-eng.htm). ~~-~~The hunting of gray seals will continue to be prohibited on Sable Island (http://www.dfo-mpo.gc.ca/seal-phoque/index_e.htm).

Canada also issues personal hunting licenses which allow the holder to take six gray seals annually (Lesage and Hammill 2001). Hunting is not permitted during the breeding season and some additional seasonal/spatial restrictions are in effect (Lesage and Hammill 2001).

U.S: Gray seals, like harbor seals, were hunted for bounty in New England waters until the late 1960s (Katona, *et al.* 1993; Lelli, *et al*. 2009). This hunt may have severely depleted this stock in U.S. waters (Rough 1995; Lelli, *et al*. 2009). Other sources of mortality include human interactions, storms, abandonment by the mother, disease, and predation. Mortalities caused by human interactions include boat strikes, fishing gear interactions, power plant entrainment, oil spill/exposure, harassment, and shooting. The Cape Cod stranding network has documented gray seals entangled in netting or plastic debris around the Cape Cod/Nantucket area, and in recent years have made successful disentanglement attempts.

From ~~2004-2008~~2005~~-~~ to 2009, ~~305~~ ~~xxx~~224 gray seal stranding mortalities were recorded, extending from Maine to North Carolina (Table 4; NMFS unpublished data). Most stranding mortalities were in Massachusetts, which is the center of gray seal abundance in U.S. waters. Fifty-~~three~~ one (~~17.4~~22.8%) of the total stranding mortalities showed signs of human interaction (~~16 in 2004,~~ 3 in 2005, ~~and~~ 5 in 2006, 8 in 2007, ~~and~~ 21 in 2008, and ~~xxx~~14 in 2009), with 27~~29~~ having some indication of fishery interaction (~~11 in 2004,~~ 1 in 2005, 5 in 2006, 5 in 2007, ~~and~~ 7 in 2008, and ~~xxx~~9 in 2009).

~~Table 4. Gray seal (*Halichoerus grypus grypus*) stranding mortalities[a] along the U.S. Atlantic coast (2004-2008~~~~2005-2009) with subtotals of animals recorded as pups in parentheses.~~

~~State~~	~~2004~~	~~2005~~	~~2006~~	~~2007~~	~~2008~~	~~Total~~
~~ME~~	~~3 (2)~~	~~4 (1)~~	~~3~~	~~5 (1)~~	~~6 (1)~~	~~21~~
~~NH~~	~~-~~	~~-~~	~~-~~	~~1 (1)~~	~~-~~	~~1~~
~~MA~~	~~33 (7)~~	~~26 (6)~~	~~29 (5)~~	~~50 (9)~~	~~53 (4)~~	~~191~~
~~RI~~	~~8 (3)~~	~~2 (1)~~	~~2 (2)~~	~~5 (1)~~	~~7~~	~~24~~
~~CT~~	~~2 (1)~~	~~-~~	~~-~~	~~-~~	~~-~~	~~2~~
~~NY~~	~~2 (1)~~	~~7~~	~~6 (4)~~	~~21 (17)~~	~~2 (2)~~	~~38~~
~~NJ~~	~~-~~	~~2 (2)~~	~~1 (1)~~	~~5 (2)~~	~~3~~	~~11~~

~~DE~~	~~1~~	~~-~~	~~-~~		~~1 (1)~~	~~2~~
~~MD~~	~~1 (1)~~	~~3 (2)~~	~~-~~	~~1~~	~~1~~	~~6~~
~~VA~~	~~2~~	~~1~~	~~-~~	~~1~~	~~1~~	~~5~~
~~NC~~	~~-~~	~~-~~	~~2~~	~~1 (1)~~	~~1 (1)~~	~~4~~
~~Total~~	~~52 (15)~~	~~45 (12)~~	~~43 (12)~~	~~90 (32)~~	~~75 (9)~~	~~305 (80)~~
~~Unspecified seals (all states)~~	~~33~~	~~59~~	~~46~~	~~34~~	~~51~~	~~223~~

~~a. Mortalities include those which stranded dead, died at site, were euthanized, died during transport, or died soon after transfer to rehab.~~

Table 4. Gray seal (*Halichoerus grypus grypus*) stranding mortalities [a] along the U.S. Atlantic coast (2005-2009) with subtotals of animals recorded as pups in parentheses.

State	2005	2006	2007	2008	2009	Total
ME	4 (1)	3	5 (1)	6 (1)	3	21
NH	-	-	1 (1)	-	1 (1)	2
MA	26 (6)	29 (5)	50 (9)	53 (4)	52 (7)	210
RI	2 (1)	2 (2)	5 (1)	7	10 (2)	26
CT	-	-	-	-	1(1)	1
NY	7	6 (4)	21 (17)	2 (2)	16 (7)	52
NJ	2 (2)	1 (1)	5 (2)	3	4	15
DE	-	-		1 (1)	-	1
MD	3 (2)	-	1	1	1	6
VA	1	-	1	1	2	5
NC	-	2	1 (1)	1 (1)	1 (1)	5
Total	45 (12)	43 (12)	90 (32)	75 (9)	91 (19)	344 (84)
Unspecified seals (all states)	59	46	34	51	34	224

a. Mortalities include those which stranded dead, died at site, were euthanized, died during transport, or died soon after transfer to rehab.

STATUS OF STOCK

The status of the gray seal population relative to OSP in U.S. Atlantic EEZ waters is unknown, but the stock's abundance appears to be increasing in Canadian and U.S. waters. The species is not listed as threatened or endangered under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for this stock is low relative to the stock size in Canadian and U.S. waters and can be considered insignificant and approaching zero mortality and serious injury rate. The level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is unknown, but believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

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HARP SEAL (*Pagophilus groenlandicus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harp seal occurs throughout much of the North Atlantic and Arctic Oceans (Ronald and Healey 1981; Lavigne and Kovacs 1988). The world's harp seal population is divided into three separate stocks, each identified with a specific pupping site on the pack ice (Lavigne and Kovacs 1988; Bonner 1990). The largest stock is located off eastern Canada and is divided into two breeding herds. The Front herd breeds off the coast of Newfoundland and Labrador, and the Gulf herd breeds near the Magdalen Islands in the middle of the Gulf of St. Lawrence (Sergeant 1965; Lavigne and Kovacs 1988). The second stock breeds on the West Ice off eastern Greenland (Lavigne and Kovacs 1988), and the third stock breeds on the ice in the White Sea off the coast of Russia. The Front/Gulf stock is equivalent to western North Atlantic stock.

Harp seals are highly migratory (Sergeant 1965; Stenson and Sjare 1997). Breeding occurs at different times for each stock between late-February and April. Adults then assemble on suitable pack ice to undergo the annual molt. The migration then continues north to Arctic summer feeding grounds. In late September, after a summer of feeding, nearly all adults and some of the immature animals of the western North Atlantic stock migrate southward along the Labrador coast, usually reaching the entrance to the Gulf of St. Lawrence by early winter. There they split into two groups, one moving into the Gulf and the other remaining off the coast of Newfoundland. The southern limit of the harp seal's habitat extends into the U.S. Atlantic Exclusive Economic Zone (EEZ) during winter and spring.

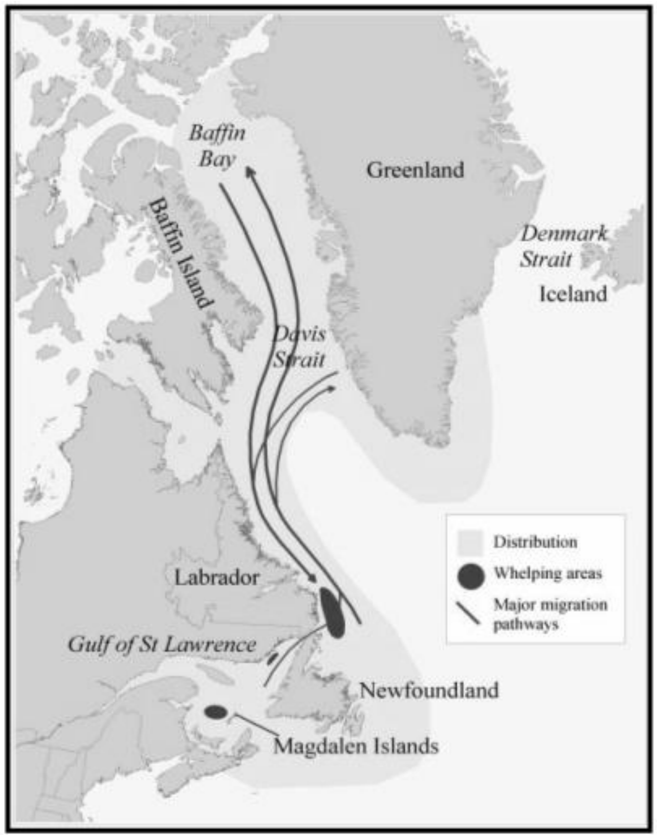

Figure 1: From: *Technical Briefing on the Harp Seal Hunt in Atlantic Canada* http://www.dfo-mpo.gc.ca/misc/seal_briefing_e.htm

Since the early 1990s, numbers of sightings and strandings have been increasing off the east coast of the United States from Maine to New Jersey (Katona *et al.* 1993; Rubinstein 1994; Stevick and Fernald 1998; McAlpine 1999; Lacoste and Stenson 2000). These extralimital appearances usually occur in January-May (Harris *et al.* 2002), when the western North Atlantic stock of harp seals is at its most southern point of migration. Concomitantly, a southward shift in winter distribution off Newfoundland was observed during the mid-1990s, which was attributed to abnormal environmental conditions (Lacoste and Stenson 2000).

POPULATION SIZE

Abundance estimates for the western North Atlantic stock are available which use a variety of methods including aerial surveys and mark-recapture (Table 1). These methods involve surveying the whelping concentrations and estimating total population adult numbers from pup production. Roff and Bowen (1983) developed an estimation model to provide a more precise estimate of total abundance. This technique incorporates recent pregnancy rates and estimates of age-specific hunting mortality (CAFSAC 1992). This model has subsequently been updated in Shelton *et al.* (1992), Stenson (1993), Shelton *et al.* (1996), and Warren *et al.* (1997). The revised 2000 population estimate was 5.5 million (95% CI= 4.5-6.4 million) harp seals. (Healey and Stenson 2000). The estimate based on the 2004 survey was calculated at 5.82 million (95% CI=4.1-7.6 million; Hammill and

Stenson 2005) but has been subsequently revised to 5.5 million (95% CI=3.8 - 7.1 million; Table 1; DFO 2007). The 2008 and 2009 estimates, respectively, based on the 2008 survey of the Gulf and Front were 6.5 million (95% CI=5.7 to 7.3 million) ~~-~~and 6.9 million (95% CI=6.0 to 7.7 million; Table 1; DFO 2010).

Table 1. Summary of abundance estimates for western North Atlantic harp seals. Year and area covered during each abundance survey, resulting abundance estimate (N_{best}) and confidence interval (CI).

Month/Year	Area	N_{best}	CI
2004	Front and Gulf	5.5 million	(95% CI 3.8-7.1 million)
2008	Front and Gulf	6.5 million	(95% CI 5.7-7.3 million)
2009	Front and Gulf	6.9 million	(95% CI 6.0-7.7 million)

Minimum population estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by (Wade and Angliss 1997). The best estimate of abundance for western North Atlantic harp seals is 6.9 million (95% CI 6.0-7.7 million; DFO 2010). The minimum population estimate based on the 2008 pup survey results is 6.5 million (CV=0.06) seals. Data are insufficient to calculate the minimum population estimate for U.S. waters.

Current population trend

Harp seal pup production in the 1950s was estimated at 645,000, but had decreased to 225,000 by 1970 (Sergeant 1975). Estimated number then began to increase and have continued to increase through the late 1990s, reaching 478,000 in 1979 (Bowen and Sergeant 1983; 1985), 577,900 (CV=0.07) in 1990 (Stenson *et al.* 1993), 708,400 (CV=0.10) in 1994 (Stenson *et al.* 2002), and 998,000 (CV=0.10) in 1999 (Stenson *et al.* 2003). The 2004 estimate of 991,000 pups (CV=0.06) was not significantly different from the 1999 estimate, which suggested that the increase in pup production observed throughout the 1990s may have abated (Stenson *et al.* 2005). The 2008 estimated of 1,076,600 pups (CV=0.06) is based on the visual aerial survey counts (DFO 2010).

The population appears to be increasing in U.S. waters, judging from the increased number of stranded harp seals, but the magnitude of the suspected increase is unknown

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a “recovery” factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size in U.S. waters is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The “recovery” factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) was set at 1.0 ~~because it was believed that harp seals are within OSP~~the population is increasing. PBR for the western North Atlantic harp seal in U.S. waters is unknown. Applying the formula to the minimum population estimate for Canadian waters results in a "PBR" of 289,220 harp seals. However, the PBR for the stock in US waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~2004~~2005-~~2008~~ 2009 the total estimated annual human caused mortality and serious injury to harp seals was ~~500,270~~441,950. This is derived from two components: 1) an average catch of 441,719~~500,075~~ seals from ~~2004~~2005-~~2008~~ 2009 by Canada and Greenland, including bycatch in the lumpfish fishery (Table 2a); and 2) ~~195~~ 231 harp seals (CV=0.~~20~~18) from the observed U.S. fisheries (Table 2b). ~~Harp seal harvests are summarized in the table below.~~

~~Table 2a. Summary of the Canadian directed catch and bycatch incidental mortality of harp seal (*Pagophilus groenlandicus*) by year.~~

~~**Fishery**~~	~~**2004**~~	~~**2005**~~	~~**2006**~~	~~**2007**~~	~~**2008**~~	~~**Average**~~
~~Commercial catches[a]~~	~~365,971~~	~~323,826~~	~~354,867~~	~~224,745~~	~~217,850~~	~~**297,452**~~
~~Commercial catch struck and lost[b]~~	~~31,026~~	~~21,495~~	~~26,674~~	~~14,914~~	~~11,724~~	~~**21,167**~~
~~Greenland subsistence catch[c]~~	~~70,586~~	~~91,696~~	~~92,210~~	~~82,778~~	~~80,648~~	~~**83,583**~~
~~Canadian Arctic[d]~~	~~1,000~~	~~1,000~~	~~1,000~~	~~1,000~~	~~1,000~~	~~**1,000**~~
~~Greenland and Canadian Arctic struck and lost[e]~~	~~71,586~~	~~92,696~~	~~93,210~~	~~83,778~~	~~81,648~~	~~**84,583**~~
~~Newfoundland lumpfish[f]~~	~~12,290~~	~~12,290~~	~~12,290~~	~~12,290~~	~~12,290~~	~~**12,290**~~
~~**Total**~~	~~**552,458**~~	~~**543,002**~~	~~**580,251**~~	~~**419,505**~~	~~**405,160**~~	~~**500,075**~~

~~a. Hammill and Stenson 2003, DFO 2003, DFO 2005; Stenson unpublished data~~

~~b. Struck and lost is calculated for the commercial harvest assuming that the rate is 5% for young of the year, and 50% for animals one year of age and older (DFO 2001, Stenson unpublished data).~~

~~c. ICES 2003, DFO 2005; Stenson unpublished data; 2002-2004 average used for 2005.~~

~~d. Hammill and Stenson 2003; Stenson unpublished data;~~

~~e. The Canadian Arctic and Greenland struck and lost rate is calculated assuming the rate is 50% for all age classes (DFO 2001; Stenson unpublished data); 2002-2004 average used for 2005.~~

~~f. DFO 2005; Stenson unpublished data; 2001-2004 average used for 2005.~~

Table 2a. Summary of the Canadian directed catch and bycatch incidental mortality of harp seal (*Pagophilus groenlandicus*) by year.

Fishery	**2005**	**2006**	**2007**	**2008**	**2009**	**Average**
Commercial catches[a]	323,826	354,867	224,745	217,850	76,668	**239,591**
Commercial catch struck and lost[b]	21,495	26,674	14,914	11,724	4,035	**15,768**
Greenland subsistence catch[c]	91,696	92,210	82,778	82,843	82,843	**86,474**
Canadian Arctic[d]	1,000	1,000	1,000	1,000	1,000	**1,000**
Greenland and Canadian Arctic struck and lost[e]	92,696	93,210	83,778	81,648	83,843	**87,035**
Newfoundland lumpfish[f]	12,290	12,290	12,290	12,290	12,290	**12,290**
Total	**543,002**	**580,251**	**419,505**	**405,160**	**260,679**	**441,719**

a. Hammill and Stenson 2003, DFO 2003, DFO 2005, DFO 2010; Stenson unpublished data

b. Struck and lost is calculated for the commercial harvest assuming that the rate is 5% for young of the year, and 50% for animals one year of age and older (DFO 2001, Stenson unpublished data).

c. ICES 2003, DFO 2005, 2010; Stenson unpublished data; 2002-2004 average used for 2005

d. Hammill and Stenson 2003; Stenson unpublished data;

e. The Canadian Arctic and Greenland struck and lost rate is calculated assuming the rate is 50% for all age classes (DFO 2001; Stenson unpublished data); 2002-2004 average used for 2005.

f. DFO 2005; Stenson unpublished data; 2001-2004 average used.

Fishery Information

U.S.

Detailed fishery information is reported in the Appendix III.

Northeast Sink Gillnet:

Annual estimates of harp seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. There were ~~168~~ 200 harp seal mortalities observed in the Northeast sink gillnet fishery between 1990 and ~~2008~~2009. The bycatch occurred principally in winter (January-May) and was mainly in waters ~~between Cape Ann and~~from New Hampshire~~. In addition, bycatch was also observed in~~ south to the shelf and shelf-edge waters southwest of Cape Cod. The stratification design used for this species is the same as that for harbor porpoise (Bravington and Bisack 1996). Estimated annual mortalities (CV in parentheses) from this fishery were: 81 (0.78) in 1999, 24 (1.57) in 2000, 26 (1.04) in 2001, 0 during 2002-2003, 303 (0.30) in 2004, 35 (0.68) in 2005, 65 (0.66) in 2006, 119 (0.35) in 2007, ~~and~~ 238 (0.38) in 2008, and 415 (0.27) in 2009 (Table 2b). There were also 9, 14, 8, 18, ~~and~~ 6, and 8 unidentified seals observed during 2004 through ~~2008~~ 2009 respectively. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during ~~2004~~2005-~~2008~~ 2009 was ~~152~~ 174 harp seals (CV= 0.~~19~~27) (Table 2b).

A study on the effects of two different hanging ratios in the bottom set monkfish gillnet fishery on the bycatch of cetaceans and pinnipeds was conducted by NEFSC in 2009 and 2010. Commercial fishing vessels from Massachusetts and New Jersey were used for the study which took place south of the Harbor Porpoise Take Reduction Team Cape Cod South Management Area (south of 40° 40´) in February, March and April. One hundred fifty-nine hauls with eight research strings each were completed during the course of the study. Results showed that while a 0.33 mesh performed better at catching commercially important finfish than a 0.50 mesh, there was no statistical difference in cetacean or pinniped bycatch rates between the two hanging ratios (Schnaittacher 2011).

Mid-Atlantic Gillnet:

No harp seals were taken in observed trips during 1993-1997or 1999-2006. One harp seal was observed taken in both 1998 and 2007, ~~and four~~ 4 were taken in 2008, and 3 in 2009. ~~Observed effort from 1993 to 2008 was scattered between New York and North Carolina from 1 to 9 km off the beach.~~ All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 0 in 1995-1997, 17 in 1998 (1.02), 0 in 1999-2006 38 in 2007, ~~and~~ 176 (0.74) in 2008, and 70 (0.67) in 2009. ~~In 2002, 65% of observer coverage was concentrated in one area and not distributed proportionally across the fishery. Therefore observed mortality is considered unknown in 2002.~~ Average annual estimated fishery-related mortality attributable to this fishery during ~~2004~~2005-~~2008~~ 2009 was ~~43~~ 57 harp seals (CV=0.50~~.63~~) (Table 2b).

Northeast Bottom Trawl

~~Three~~ Four mortalities were observed in the Northeast bottom trawl fishery between 2002 and ~~2008~~2009. The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 0 between 1991 and 2000, 49 (CV=1.10) in 2001, and 0 in 2002-2004, and 0 in 2006–2008. Estimates have not been generated for 2005 or 2009.

Table 2b. Summary of the incidental mortality of harp seal (Pagophilus groenlandicus) by commercial fishery including the years sampled (Years), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Data Type [a]	Observer Coverage [b]	Observed Mortality[c]	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet[e]	~~04~~05-~~08~~09	Obs. Data, Trip Logbook, Allocated Dealer Data	~~.06,~~ .07, .04, .07, .05, .04	~~15,~~ 3, 3, 11, 14, 32	~~303,~~ 35, 65, 119, 238, 415	~~.30,~~ .68, .66, .35, .38, .27	~~152~~ 174 (0.~~19~~18)

Mid-Atlantic Gillnet	~~04~~05-~~08~~09	Obs. Data, Trip Logbook, Allocated Dealer Data	~~.02,~~ .03, .04, .05, .03, .03	~~0,~~ 0, 0, 1, 4, 3	~~0,~~ 0, 0, 38, 176, 70	~~0,~~ 0, 0, 0.9, .74, .67	~~43~~ 57 (0.~~63~~5)
Northeast Bottom Trawl[d]	~~04~~05-~~08~~09	Obs. Data Weighout	~~.05,~~ .12, .06, .06, .08, .09	~~0,~~ 3, 0, 0, 0, 1	~~0,~~ unk, 0, 0, unk	~~0,~~ unk, 0, 0, 0, unk	unk
TOTAL							~~195~~ 231 (0.~~20~~18)

a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. The Northeast Fisheries Observer Program collects landings data (Weighout) and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery.

b. The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic coastal sink gillnet fisheries are ratios based on tons of fish landed. North Atlantic bottom trawl fishery coverages are ratios based on trips.

c. Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 2000-~~2008~~2009, respectively, 2, 1, 0, 0, 4, 0, 3, 0, ~~and~~ 3, and 4 takes were observed in nets with pingers. In 2000-~~2008~~2009, respectively, 1, 0, 0, 0, 11, 3, 0, 12, ~~and~~ 15 and -28 takes were observed in nets without pingers.

d. Bycatch estimates attributed to the Northeast bottom trawl fishery have not been generated.

e. Nine harp seals were incidentally caught as part of a NEFSC hanging ratio study to examine the impact of gillnet hanging ratio on harbor porpoise bycatch. These animals were included in the observed interactions and added to the total estimates, though these interactions and their associated fishing effort were not included in bycatch rate calculations.

Other Mortality

Canada: Harp seals have been commercially hunted since the mid-1800s in the Canadian Atlantic (Stenson 1993). A total allowable catch (TAC) of 200,000 harp seals was set for the large vessel hunt in 1971. The TAC varied until 1982 when it was set at 186,000 seals and remained at this level through 1995 (Stenson 1993; ICES 1998). The TAC was increased to 250,000 and 275,000, respectively, in 1996 and 1997 (ICES 1998). The 1997 TAC remained in effect through 2002. In 2003, a three-year TAC was set at 975,000 with a maximum of 350,000 allowed in the first two years (ICES 2008). As a result of catches in the first two years the 2005 TAC was set at 319,517 (ICES 2008). The 2006 TAC was increased to 335,000 (325,000 commercial hunt, 6,000 Aboriginal initiative, and 2,000 allocation each for personal use and Arctic catches). The TAC was reduced to 270,000 in 2007 (263,140 commercial hunt, 4,860 for Aboriginal, and 2,000 for personal use) (ICES 2008). In 2008 the TAC was increased to 275,000 (268,050 commercial hunt, 4,950 for Aboriginal, and 2,000 for personal use). In 2009 the TAC was 280,000, and in 2010 it was 330,000.

U.S.: From ~~2004~~ 2005 to ~~2008~~2009, ~~541~~ 511 harp seal stranding mortalities were reported (Table 3; NMFS unpublished data). ~~Eighteen~~ Twenty-two (~~3~~4.3%) of the mortalities during this five-year period showed signs of human interaction (~~2 in 2004,~~ 5 in 2005, 2 in 2006, 6 in 2007, ~~and~~ 3 in 2008, and 6), with ~~3~~ 5 having some sign of fishery interaction (1each in 2005, 2007 and 2008 and 2 in 2009)). However, the cause of death of stranded animals is not being evaluated (interactions may be non-fatal or even post-mortem) and is not included in annual human-induced mortality estimates. Harris and Gupta (2006) analyzed NMFS 1996-2002 stranding data and suggest that the distribution of harp seal strandings in the Gulf of Maine is consistent with the species' seasonal migratory patterns in this region.

Table 3. Harp seal (*Pagophilus groenlandicus*) stranding mortalities[a] along the U.S. Atlantic coast (2004-2008) with subtotals of animals recorded as pups in parentheses.						
State	2004	2005	2006	2007	2008	Total
ME	30	10	14	8	15	77
NH	-	2	-	1	1	4
MA	85	44	24	51 (2)	51	255
RI	7	9	6	2	5	29
CT	2	3	4	1	2	12
NY	20	41	15	19 (1)	8	103
NJ	6	12	3 (1)	3	12	36
DE	0	2 (1)	-	2	-	4
MD	-	2	-	4	1	7
VA	1	4	-	5	3	13
NC	-	-	1	-	-	1
Total	**151**	**129**	**67**	**96**	**98**	**541**
Unspecified seals (all states)	33	59	46	34	51	223
a. Mortalities include animals found dead and animals that were euthanized, died during handling, or died in the transfer to, or upon arrival at, rehab facilities.						

Table 3. Harp seal (*Pagophilus groenlandicus*) stranding mortalities[a] along the U.S. Atlantic coast (2005-2009) with subtotals of animals recorded as pups in parentheses.						
State	2005	2006	2007	2008	2009	Total
ME	10	14	8	15	9	56
NH	2	-	1	1	4	8
MA	44	24	51 (2)	51	59 (2)	229
RI	9	6	2	5	9	31
CT	3	4	1	2	3	13
NY	41	15	19 (1)	8	29	112
NJ	12	3 (1)	3	12	5	35
DE	2 (1)	-	2	-	-	4
MD	2	-	4	1	2	9
VA	4	-	5	3	1	13
NC	-	1	-	-	-	1
Total	**129**	**67**	**96**	**98**	**121**	511
Unspecified seals (all states)	59	46	34	51	34	224
a. Mortalities include animals found dead and animals that were euthanized, died during handling, or died in the transfer to, or upon arrival at, rehab facilities.						

STATUS OF STOCK

The status of the harp seal stock, relative to OSP, in the U.S. Atlantic EEZ is unknown, but the stock's abundance appears to have stabilized. The species is not listed as threatened or endangered under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for this stock is very low relative to the stock size and can be considered insignificant and approaching zero mortality and serious injury rate. The level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is also low relative to the total stock size; therefore, this is not a strategic stock.

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