~~October~~ May 2008~~2007~~

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Individuals of the western North Atlantic ~~northern~~ right whale population range from wintering and calving grounds in coastal waters of the southeastern United States to summer feeding and nursery grounds in New England waters and northward to the Bay of Fundy, ~~the~~ Scotian Shelf, and ~~the~~ 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.~~; i~~ In addition, recent resightings of photographically identified individuals have been made off Iceland, ~~arctic Norway and~~ in the old Cape Farewell whaling ground east of Greenland ~~(~~(Hamilton *et al.* 2007)~~Hamilton *et al*, 2007)~~ , and northern Norway (Jacobsen *et al.* 2004). The Norwegian sighting (~~in~~ September 1999) 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. ~~Similarly,~~The few published records from the Gulf of Mexico (Moore and Clark 1963; Schmidly *et al.* 1972) represent either distributional~~geographic~~ 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 ~~most~~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 ~~s~~Southeast recorded since comprehensive surveys began in the calving grounds. Therefore, ~~T~~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 ~~northern~~ 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 may be more extensive than thought. In 2000, one whale was photographed in Florida waters on 12 January ~~12th, and~~ then again ~~then seen~~ eleven days later (23 January~~.23rd~~) in Cape Cod Bay~~.~~, ~~In~~ less than a month ~~the same animal was resighted~~later off ~~of~~ Georgia ~~on~~ (16 February)~~, 16th~~ and ~~then~~ back in Cape Cod Bay on 23 March~~-23, 2007~~, effectively making the round~~-~~-trip migration to the ~~s~~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 (Baumgartner and Mate 2005; Mate *et al.* 1997)~~(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). ~~As surveys continue, patterns of right whale use in between Charleston and Cape Hateras are beginning to emerge (Pabst, pers comm.)~~ The Northeast Fisheries Science Center conducts an extensive multi-year aerial survey program throughout the Gulf of Maine region; this program is intended to better establish the distribution of right whales, including evaluating inter-annual variability in right whale occurrence in previously poorly studied habitats.

New England waters are a primary feeding habitat for right whales, which feed primarily on copepods (largely of the genera *Calanus* and *Pseudocalanus*) in this area. 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). ~~Acceptable surface copepod resources are limited to perhaps 3% of the region during the peak feeding season in Cape Cod and Massachusetts Bays (C. Mayo pers. comm.).~~ 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). In addition, New England waters serve as a nursery area for calves. NMFS (National Marine Fisheries Service) and Center for Coastal Studies aerial surveys during springs of 1999-2005 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. The consistency with which right whales occur in such locations is relatively high, but these new data further highlight high interannual variability in right whale use of some habitats.

Genetic analyses based upon direct sequencing of mitochondrial DNA (mtDNA) have identified five mtDNA haplotypes in the western North Atlantic northern right whale (Malik *et al.* 1999). 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 from sequence data by Malik *et al.* (2000). These findings might be indicative of inbreeding in the population, but no definitive conclusion can be reached using current data. Additional work comparing modern and historic genetic population structure in right whales, using DNA extracted from museum and archaeological specimens of baleen and bone, is also underway (Rosenbaum *et al.* 1997; 2000). Preliminary resultshas suggested that the eastern and western North Atlantic populations were not genetically distinct (Rosenbaum *et al.* 1997; 2000)(Rosenbaum *et al.* 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. Results of gGenetic studies concluded do show that the principal loss of genetic diversity occurred prior to the 18th century (Waldick *et al.* 2002). However, revised conclusions of species composition in North American Basque whaling archaeological sites (Rastogi *et al.* 2004) These recent findings contradict the It was previously held belief believed that Basque whaling during the 186th and 197th centuryies was principally responsible for the loss of genetic diversity in the North Atlantic right whale,. Results also suggest that, as expected, the principal loss of genetic diversity occurred during major exploitation events prior to the 20th century.

High--resolution (using 35 microsatellite loci) genetic profiling, using biopsy samples, has been completed for 66% of all identified NnNorth Atlantic right whales through 2001. This analysis has generated much information regardingwork ha improved our understanding of genetic variability in the population, number of reproductively active individuals, and reproductive fitness,. This growing genetic database, integrated with the photo-identification catalog, has given researchers much information regarding reproductive success , parentage and relatedness of individuals. The ability to genetically identify individuals also plays a significant role in identifying animals that otherwise would remain unknown, such as dead whales and animals associated with fecal samples (Frasier *et al.* 2007).

One emerging componentresult of the genetic studies is the importance of obtaining biopsy samples from calves while still with their mothers in 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 remainder, 40% of all calves born, are not taken to a known summering ground. Since obtaining the calf's genetic profile is the only reliable way to establish parentage, if they arethe calf is not sampled when associated with theirits mother early on, then it is not possible to link themit with a calving event or to itstheir 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 informationare therefore 'unidentified calves'. (Frasier *et al.* 2007). An additional interpretation of paternity analyses indicates that the population size may be larger than was previously estimatedthought. Fathers for only 45% of known calves have been sampledgenetically determined. However, genetic profiles were available for 69% of all photo-identified males (Frasier 2005). The conclusions was Results indicate that the majority of these calves must have different fathers which cannot be accounted for by and so the few identified unsampled males and the population of males must be larger. (To date, skin biopsy sampling has resulted in the compilation of a DNA library of more than 300 North Atlantic right whales. When work is completed, a genetic profile will be established for each individual, and an assessment provided on the level of genetic variation in the population, the number of reproductively active individuals, reproductive fitness, the basis for associations and social units in each habitat area, and the mating system. Tissue analysis has also aided in sex identification: the sex ratio of the photo-identified and catalogued population appears slightly skewed toward males (196M:187F). Analyses based on both genetics and sighting histories of photographically identified individuals also suggest that in this stock approximately one third of the

~~females with calves use summer feeding grounds other than the Bay of Fundy (New England Aquarium, unpublished data). As described above, a related question is where individuals other than calving females and a few juveniles overwinter. One or more additional wintering and summering grounds may exist in unsurveyed locations, although it is also possible that missing animals simply disperse over a wide area at these times. Identification of such areas, and the possible threats to right whales there, is a research priority.~~Frazier~~'s analysis~~ (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

Based on a census of individual whales identified using photo-identification techniques and an assumption of mortality of whales not seen in seven years, the western North Atlantic stock size was estimated to be 295 individuals in 1992 (Knowlton *et al.* 1994). An updated analysis using the same method gave an estimate of 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). A review of the photo-~~id~~ ID recapture database on 30 ~~June~~May ~~3015,~~ 2007~~6,~~ indicated that 325~~13~~ individually recognized whales in the catalog were known to be alive during 2003~~1~~. With the exception of calves of the year and a few probably unique but as yet uncatalogued individuals, this number represents a nearly~~Because this was a nearly~~ complete census~~.~~ and therefore ~~I, it is assumed that this estimate~~ represents a minimum population size. ~~However, n~~No estimate of abundance with an associated coefficient of variation has been calculated for the population.

Historical Abundance

An estimate of pre-exploitation population size is not available. Basque whalers ~~may~~ were thought to have taken right whales during the 1500s in the Strait of Belle Isle region (Aguilar 1986), although genetic analysis has shown that ~~a large percent~~nearly all of the remains found in that area are, in fact, those of bowhead whales (Frasier *et al.* 2007; Rastogi *et al.* 2004)~~(Rastogi *et al.* 2004)~~. 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)~~(Reeves and Mitchell 1987)~~. 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 ~~(1987)~~ could conclude only that there were at least hundreds of right whales present in the western North Atlantic during the late 1600s. ~~In a later study~~ Reeves *et al.* (1992)~~(Reeves *et al.* 1992),~~ plotted a series of population trajectories ~~were plotted~~ using historical data and assuming a present day population size of 350 animals. The results ~~suggest~~ suggested that there may have been at least 1,000 right whales in the population during the early to mid-1600~~'~~s, 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; Kenney *et al.* 1995; Reeves *et al.* 1992)~~(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 325~~13~~ individuals in 2003~~2~~ 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 2003~~2~~, but not recorded in the individual sightings database as seen during from 1 January 2004~~2~~ to 30~~15~~ May~~June~~ 2007 (note that matching of photos from 2006 and 2007 is not complete)~~5~~. It also does not include any calves known to be born during 2003~~2~~, but not yet entered as new animals in 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).

Some indication of trend is evident by examination of the minimum number alive population index ~~as~~ calculated from the individual sightings database, as it existed on ~~June 15 2006~~30 May 2007, for the years 1990~~5~~-2003~~2~~ (Figure 1~~a&bTable1~~). These data reveal a significant ~~indicate a slight~~ 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 1.8%.

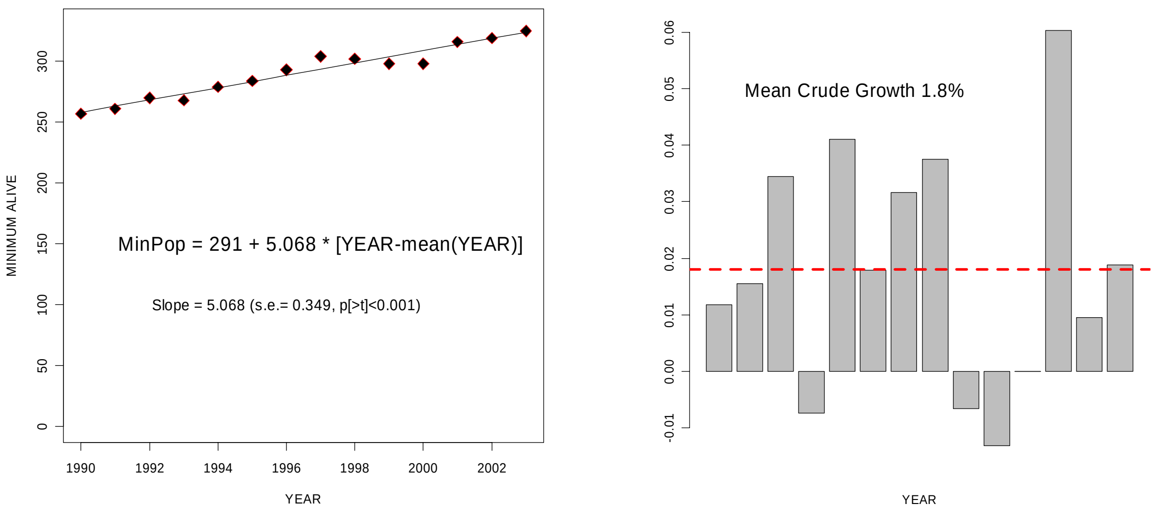

Figure 1. Minimum number alive (a) and ~~annual~~ crude annual growth rate (b) for catalog~~u~~ed North Atlantic ~~northern~~ right whales. Minimum number of catalog~~u~~ed individuals known to be alive in any given year includes all whales known to be alive prior to that year and seen in that year or subsequently plus all whales newly catalogued that year. It does not include calves born that year but not yet catalogued.

~~Later years~~The index may increase slightly in later years as analysis of the backlog of unmatched but ~~high~~ high-quality photographs proceeds, with animals~~are~~ matched to previously known individuals ~~or become~~added to the catalog as newly identified whales. For example, the minimum number alive for 2002 was calculated to be 313 from a 15 June 2006 data set and revised to ~~319~~ 325 using the ~~15~~ 30 May 2007 data.

Recent mortalities, including those in the first half of 2005, suggest an increase in the annual mortality rate (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 these recent mortalities, six were adult females, three of which were carrying near-term fetuses. Furthermore, four of these females were just starting to bear calves, and since the average lifetime calf production is 5.25 calves (Fujiwara and Caswell 2001), the deaths of these females represent a lost reproductive potential of as many as 21 animals.

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).

~~Since that report, t~~Total reported calf production and calf mortalities from 1993 to 2007 are shown below in Table 1. The mean calf production for this fifteen year period was ~~in 92/93 was 89; 93/94, 9; 94/95, 7; 95/96, 221; 96/97, 2019; 97/98, 65; 98/99, 4; 99/00, 1; 00/01, 31; 01/02, 21; 02/03, 19; 03/04, 176; 04/05 28;, 05/06 19; and 06/07 22 [mean 14.9~~15.6~~ ,~~ (13.7~~0~~-17.~~1~~7; 95% C.I)~~]~~. In addition, one calf was reported as a serious injury in 2002 and during the 2005 calving season three adult females were found dead with near term fetuses.

Table 1: North Atlantic right whale calf production and mortality, 1993-2007		
Year[a]	Reported calf production	Reported calf mortalites
1993	8	2
1994	9	
1995	7	
1996	22	3
1997	20	1
1998	6	1
1999	4	
2000	1	
2001	31	4
2002	21	2
2003	19	
2004	17	
2005	28	
2006	19	
2007	22	
a. includes December of the previous year		

However, this total calf production should be reduced by reported calf mortalities: 2 mortalities in 1993, 3 in 1996, 1 in 1997, 1 in 1998, 4 in 2001 and 2 in 2002. During 2002, 2 mortalities and 1 serious injury involved what were likely calves from 00/01. Of the three calf mortalities in 1996, available data suggested one was not included in the reported 21 mother/calf pairs, resulting in a total of 22 calves born. During 04/05 calving season, 3 adult females were found dead with near term fetuses. Eleven of the 21 mothers in 1996 were observed with calves for the first time (i.e., were "new" mothers that year). Three of these were at least 10 years old, 2 were 9 years old, and 6 were of unknown age. An updated analysis of calving interval through the 1997/1998 season suggests that mean calving interval increased since 1992 from 3.67 years to more than 5 years, a significant trend (Kraus *et al.* 2001). This conclusion is 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 *E. australis*. A workshop on possible causes of reproductive failure was held in April 2000 (Reeves *et al.* 2001)(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 years (Krauss *et al.* 2007).

The annual population growth rate during 1986-1992 was estimated to be 2.5% (CV=0.12) using photo-identification techniques (Knowlton *et al.* 1994). A population increase rate of 3.8% was estimated from the annual increase in aerial sighting rates in the Great South Channel, 1979-1989 (Kenney *et al.* 1995). However, as noted above, more recent work indicated that the population was in decline in the 1990s (Caswell *et al.* 1999, Best *et al.* 2001).

An analysis of the age structure of this population suggests that it contains a smaller proportion of juvenile whales than expected (Best *et al.* 2001; Hamilton *et al.* 1998)(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, little few data are available on either factor and senescence has not been documented for any baleen whale.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is specified as 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)(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). However, in view of the population decline indicated by recent demographic analyses Recent publications report unacceptable levels of mortality (Best *et al.* 2001)(Caswell *et al.* 1999; Best *et*

~~*al.* 2001)~~, and forecast a high probability that North Atlantic right whales will go extinct in 200 years if anthropogenic mortality is not curtailed (Fugiwara and Caswell 2001); therefore, the PBR for this population is set to zero.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period ~~2001~~ 2002 through ~~2005~~2006, the minimum rate of annual human-caused mortality and serious injury to right whales averaged 3.~~2~~8 per year (U.S. waters, 2.~~0~~4; Canadian waters, 1.~~2~~4). This is derived from two components: 1) non-observed fishery entanglement records at 1.4 per year (U.S. waters, 0.~~4~~6; Canadian waters, ~~1.0~~0.8), and 2) ship strike records at ~~1.8~~2.4 per year (U.S. waters, 1.~~6~~8; Canadian waters, 0.~~2~~6). 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)~~(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 ~~Nelson~~ Glass *et al.* (2008)~~2007~~.

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 most 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 harmful as the whale grows (Cole *et al.* 2005; Nelson *et al.* 2007)~~(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)~~(Cole *et al.* 2005; Nelson *et al.* 2007)~~. 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)~~(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 estimated annual average human-induced mortality and serious injury incurred by this stock (including fishery and non-fishery related causes) is 3.~~2~~8 right whales per year (U.S. waters ~~2.0~~2.4; Canadian waters, ~~1.2~~1.4). 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 3.~~2~~8 right whales per year must be regarded as a minimum estimate (Glass *et al.* 2008)~~(Nelson *et al.* 2007)~~.

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 were recorded (Glass *et al.* 2008; IWC [International Whaling Commission] 1999; Knowlton and Kraus 2001)~~(IWC [International Whaling Commission] 1999; Knowlton and Kraus 2001)~~. Of these, 13 (28.9%) were neonates that ~~are~~ were believed to have died from perinatal complications or other natural causes. Of the remainder, 16 (35.6%) ~~were~~ 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 ~~2001~~ 2002 through ~~2005~~2006, 7 of ~~16~~ 19 records of mortality or serious injury (including records from both USA and Canadian waters) involved entanglement or fishery interactions. 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 ~~2001~~ 2002 through ~~2005~~2006, there were at least ~~five~~ four documented cases of entanglements for which the intervention of disentanglement teams averted a likely ~~serious~~ serious-injury determination. ~~On 7/20/01, #2427, a seven-year-old male was sighted off Portsmouth, New Hampshire, with line wrapped tightly around the rostrum and through the mouth. The whale was disentangled later that day, and subsequent resightings indicated that the injuries were healing. However, observers also noted that the whale's baleen was damaged, and that the whale was holding its head high out of the water and not diving as frequently as other whales in the area.~~ A yearling male, #3120, first sighted off the North Carolina coast on 4/7/02, may have avoided serious injury due to being partially disentangled on 8/25/02 by researchers in the Bay of Fundy, Canada. An unidentified right whale was disentangled in the Bay of Fundy, Canada on 7/09/03. The gear was tentatively identified as US lobster gear and other unknown gear. On 12/6/04, a one-year-old of unknown gender, #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 12/3/~~December 3, 20~~05, #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 6/12/~~20~~06, apparently ~~gear~~ gear-free. Sometimes, even with disentanglement, an animal may die of injuries sustained from fishing gear. A female yearling right whale, #3107 (see Table 2) 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).

Bycatch of a right whale has been observed by the Northeast Fisheries Observer Program in the pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in any of the other fisheries monitored by NMFS. The only bycatch of a right whale documented by the Northeast Fisheries Observer Program was a female released from a pelagic drift gillnet in 1993.

Entanglement records from 1990 through 2006 maintained by NMFS Northeast Regional Office (NMFS, unpublished data) included 45 confirmed right whale entanglements, including right whales in weirs, in gillnets, and in 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, ~~a total of 75.6%~~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). ~~Entanglement records from 1970 through 2004 maintained by NMFS Northeast Regional Office (NMFS, unpublished data) included at least 92 right whale entanglements or possible entanglements, including right whales in weirs, in gillnets, and in trailing line and buoys. An additional record (M. J. Harris, pers. comm.) reported a 9.1-10.6m right whale entangled and released south of Ft. Pierce, Florida, in March 1982 (this event occurred during a sampling program and was not related to a commercial fishery).~~ 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 becoming 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 (Knowlton and Kraus 2001; Kraus 1990)~~(Kraus 1990; Knowlton and Kraus 2001)~~. Records from ~~2001~~ 2002 through ~~2005~~ 2006 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 ~~1.8~~2.4 whales per year (U.S. waters, 1.~~6~~8; Canadian waters, 0.~~2~~6). In 2000, two right whales were sighted in the Bay of Fundy with large open wounds that were likely the result of collisions with vessels. Right whale #2820, a male of unknown age, was first seen injured on 7/9/00. He was sighted intermittently throughout the remainder of that summer, was seen again in the Bay of Fundy in 2001 and seen once in 2002~~-~~. The second whale, #2660, was a five-year-old female who was sighted with a wound on the left side of her head, just forward of the blowholes. She ~~has~~ was seen with a calf in December 2005. Although both of these injuries were gruesome in appearance, in the absence of a chronic stressor (i.e., entangling fishing gear), they were apparently not fatal.

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic right whales, January 2002 through December 2006.

Date[a]	Report Type[b]	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
7/6/02	mortality	Yearling Female #3107 11m	Observed alive off Briar Island, NS		P	Carcass ashore on Nantucket, MA; caudal peduncle severely lacerated where entangled; gear consistent with inshore lobster fishery
8/22/02	serious injury	Adult Female #1815	Scotian Shelf, Canada		P	Line tightly wrapped around head and tail stock; no gear recovered
8/22/02	mortality	Yearling Female 12.6m	off Ocean City, MD	P		Large laceration on dorsal surface
8/30/02	serious injury	age & sex unknown #3210	Bay of Fundy, NS		P	Line tightly wrapped around rostrum; resighted in 2004 in poor condition; no gear recovered
1/14/03	serious injury	Adult Female #2240	Jacksonville, FL		P	Body condition poor; no gear recovered
10/02/03	mortality	Adult Female #2150 15m (est)	Digby, NS	P		Large fracture in skull; subdermal hemorrhage
2/7/04	mortality	Adult Female #1004 16m	Virginia Beach, VA	P		Severe subdermal bruising; complete fracture of rostrum and laceration of oral rete
9/6/04	mortality	Adult Female #2301	Roseway Basin, NS		P	Extensive constricting line on head and left flipper; found dead March 3, 2005 on Ship Shoal Island, VA

		15m (est)				
11/24/04	mortality	Adult Female #1909 14.9m	Ocean Sands, NC	P		Left fluke lobe severed and large bore blood vessels exposed
1/12/05	mortality	Adult Female #2143 13m	Cumberland Island, GA	P		Healed propeller wounds from strike as a calf re-opened as a result of pregnancy
3/10/05	serious injury	age & sex unknown #2425	Cumberland Island, GA	P		43 ft power yacht partially severed left fluke; resighted 9/4/05 in extremely poor condition
4/28/05	mortality	Adult Female #2617 14.7m	Monomoy Island, MA	P		Significant bruising and multiple vertebral fractures
1/10/06	mortality	Calf Male 5.4m w/out fluke	Jacksonville, FL	P		Propeller lacerations associated with hemorrhaging and edema; flukes completely severed
1/16/06	serious injury	Calf 5m (est)	Corpus Christi Bay, TX		P	Wrapping laceration with heavy cyamid load on dorsal surface of calf; vertebral processes noticeable indicating fat loss
1/22/06	mortality	Calf 5.6m	off Ponte Vedra Beach, FL		P	Significant pre-mortem lesions from entanglement in apparent monofilament netting
3/11/06	serious injury	Yearling Male #3522	Off Cumberland Island, GA	P		11 propeller lacerations across dorsal surface
7/24/06	mortality	age unknown Female 9.6m	Campobello Island, NB	P		Propeller lacerations through blubber, into muscle and ribs
8/24/06	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

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.

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic right whales, January 2001 through December 2005.

Date[a]	Report Type[b]	Sex, age, ID	Location[a]	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh inter	
3/17/01	mortality	Male calf	Assateague, VA	P		Large fresh propeller gashes on dorsal caudal and acute muscular hemorrhage
6/8/01	serious injury	Adult male #1102	58 mi east of Cape Cod, MA		P	Entangling gear deeply embedded; numerous signs of poor health including emaciation, skin discoloration, and abnormal cyamid distribution
6/18/01	mortality	female calf	Long Island, NY	P		Dorsal propeller wounds, sub-dermal hemorrhage
11/3/01	mortality	14 m Adult male #1238	Magdellen Islands, Canada		P	Thoroughly wrapped up in Danish Seine gear, whale seen alive and well five months earlier
7/6/02	mortality	11 m female #3107	Observed alive off Briar Island, NS Canada		P	carcass ashore on Nantucket, MA; caudal peduncle severely lacerated where entangled; gear consistent with inshore lobster fishery
8/22/02	serious injury	Adult female #1815	Scotian Shelf, Canada		P	line tightly wrapped around head and tail stock; no gear recovered
8/22/02	mortality	12.6m female 1y.o.	off Ocean City, MD	P		large laceration on dorsal surface
8/30/02	serious injury	#3210 age & sex unknown	Bay of Fundy, NS		P	line tightly wrapped around rostrum, resighted in 2004 in poor condition; no gear recovered
1/14/03	serious injury	Adult female #2240	Jacksonville, FL		P	body condition poor; no gear recovered
10/02/03	mortality	Adult female #2150	Digby, NS	P		Large fracture in skull, sub-dermal hemorrhage
2/7/04	mortality	Adult female #1004	Virginia Beach, VA	P		Severe subdermal bruising, complete fracture of rostrum and laceration of oral rete.
9/6/04	mortality	Adult female #2301	Roseway Basin, NS		P	Extensive constricting line on head and left flipper. Found dead March 3, 2005 on Ship Shoal Island, VA.
11/24/04	mortality	Adult female #1909	Ocean Sands, NC	P		Left fluke lobe severed and large bore blood vessels exposed.
1/12/05	mortality	Adult female	Cumberland Island, GA	P		Healed propeller wounds from strike as a calf re-opened as a result of

		#2143				pregnancy
3/10/05	serious injury	#2425 age & sex unknown	Cumberland Island, GA	P		43' power yacht partially severed left fluke; resighted 9/4/05 in extremely poor condition
4/28/05	mortality	Adult female #2617	Monomoy Island, MA	P		Significant bruising and multiple vertebral fractures

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.

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). 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). A National Marine Fisheries Service ESA 1996 review of Northern Atlantic Right Whale status concluded that the western North Atlantic population of the northern right whale remains endangered [Note that 'northern right whale' is nomenclature that is now outdated in the scientific literature but not yet modified in rule makings. Scientific literature recognizes north Atlantic and north Pacific right whales as two distinct species].; this 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 has been a minimum of 3.2 8 right whales per year from 2001 2002 through 20052006. Given that PBR has been set to zero, 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 Northern 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; 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 (IWC 2002).

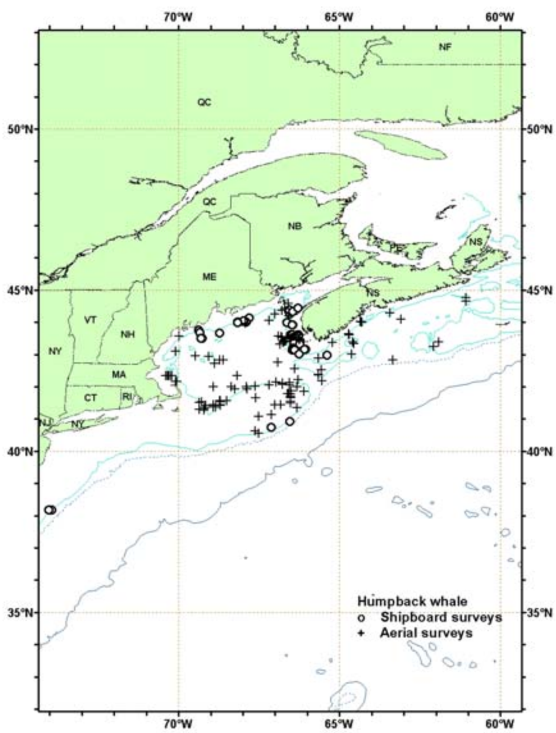

Figure 1. *Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth*

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 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 (36 of 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 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 effective range of many members of the Gulf of Maine stock does not extend onto the Scotian Shelf.

During winter, whales from most identified Atlantic feeding areas (including the Gulf of Maine) mate and calve in the West Indies, where spatial and genetic mixing among subpopulations occurs (Clapham *et al.* 1993; Katona and Beard 1990; Palsbøll *et al.* 1997; Stevick *et al.* 1998). A few whales of unknown northern origin migrate to the Cape Verde Islands (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, 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 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~~; Florida DEP unpublished data~~). Whether the increased 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 (the closest feeding ground) and other areas in the North Atlantic. Of 21 live whales, 9 (42.9%) 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 for more than one purpose.

In New England waters, feeding is the principal activity of humpback whales, and their distribution in this region has been largely correlated to prey species and abundance, although behavior and bottom topography are factors in foraging strategy (Payne *et al.* 1986, 1990). Humpback whales are frequently piscivorus 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 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 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, Center for Coastal Studies and College of the Atlantic).

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

Population estimates have been generated for the total North Atlantic population of humpback whales as well as for the Gulf of Maine stock. The estimate of 11,570 humpback whales (CV=0.068) is regarded as the best available for the North Atlantic, although because YONAH sampling was not spatially representative in the feeding grounds, this value is negatively biased. The best recent estimate for the Gulf of Maine stock is 847 whales (CV=0.55), derived from the 2006 aerial survey. This estimate is not significantly different from the 1999 estimate of 902 (CV=0.41).

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). Since 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

Estimating abundance for the Gulf of Maine stock has proved problematic. Three approaches have been investigated: mark-recapture estimates, minimum population size from photo-ids, and line-transect sample estimates. Most of the mark-recapture estimates were affected by heterogeneity of sampling, which was heavily focused on the southwestern Gulf of Maine. However, an estimate of 652 (CV=0.29) derived from the more extensive and representative YONAH sampling in 1992 and 1993 is probably less subject to this bias.

The minimum population size approach used photo-identification data to estimate the minimum number of humpback whales known to be alive in a particular year, 1997. By determining the number of identified individuals seen either in that year, or in both a previous and subsequent year, it is possible to determine that at least 497 humpbacks were alive in 1997. This figure is also likely to be negatively biased, again because of heterogeneity of sampling. A similar calculation for 1992 (which would correspond to the YONAH estimate for the Gulf of Maine) yields a figure of 501 whales.

In 1999 a line-transect sighting survey was conducted from 28 July to 31 August by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Total track line length was 8,212km. However, in light of the information on stock identity of Scotian Shelf humpback whales noted above, only the portions of the survey covering the Gulf of Maine were used; surveys blocks along the eastern coast of Nova Scotia were excluded. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) which accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Clapham *et al.* 2003; Palka 2000). These surveys yielded an estimate of 816 humpbacks (CV=0.45). However, given that the rate of exchange between the Gulf of Maine and both the Scotian Shelf and mid-Atlantic region is not zero, this estimate is likely to be conservative. Accordingly, inclusion of data from 25% of the Scotian Shelf survey area (to reflect the match rate of 25% between the Scotian Shelf and the Gulf of Maine) gives an estimate of 902 whales (CV=0.41).

Gulf of Maine Stock - Recent surveys and abundance estimates

~~In 1999 a line-transect sighting survey was conducted from 28 July to 31 August by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Total track line length was 8,212km. However, in light of the information on stock identity of Scotian Shelf humpback whales noted above, only the portions of the survey covering the Gulf of Maine were used; surveys blocks along the eastern coast of Nova Scotia were excluded. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) which accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Clapham *et al*. 2003; Palka 2000). These surveys yielded an estimate of 816 humpbacks (CV=0.45). However, given that the rate of exchange between the Gulf of Maine and both the Scotian Shelf and mid-Atlantic region is not zero, this estimate is likely to be conservative. Accordingly, inclusion of data from 25% of the Scotian Shelf survey area (to reflect the match rate of 25% between the Scotian Shelf and the Gulf of Maine) gives an estimate of 902 whales (CV=0.41).~~

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 data of 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 m depth contour on the southern Georges Bank to the lower Bay of Fundy; while the Scotian 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 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.) Because the Scotian 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.

Month/Year	Type	N	CV
~~July/August 1999~~	~~Line transect, including a portion of the Scotian Shelf stratum~~	~~902~~	~~0.41~~
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 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, for purposes of this assessment the maximum net productivity rate was assumed to be the default value of 0.04 for cetaceans (Barlow *et al.* 1995).

Current and maximum net productivity rates are unknown for the North Atlantic population overall. As noted above, Stevick *et al.* (2003) calculated an average population growth rate of 3.1% (SE=0.005) for the period 1979-1993.

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 549. 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 ~~2001~~ 2002 through ~~2005~~2006, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged 4.~~2~~ 4 animals per year (U.S. waters, ~~3.8~~4.0; Canadian waters, 0.4). This value includes incidental fishery interaction records, ~~2.8~~3.0 (U.S. waters, 2.~~4~~6; Canadian waters, 0.4); and records of vessel collisions, 1.4 (U.S. waters, 1.4; Canadian waters, 0) (~~Nelson~~ Glass *et al.* ~~2007~~2008).

In contrast to ~~previous~~ stock assessment~~s~~ 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. ~~This year~~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 ~~5~~ 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~~that the population contains a greater percentage of mature animals than was 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 2000-2006 (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.

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), injuries possibly attributable to ship strikes are more common and probably more serious than those from entanglements. In the NMFS records for 2002 through 2006, 9 records had some evidence of a collision with a vessel. Of these, 7 were mortalities as a result of the collision. 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 *et al.* 2008).

Fishery-Related Serious Injuries and Mortalities

A description of 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 200m 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 relevant to comparison to PBR, 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).

For this report, the records of dead, injured, and/or entangled humpbacks (found either stranded or at sea) for the period ~~2001~~ 2002 through ~~2005~~ 2006 were reviewed. Humpbacks were involved in 162 reported events. Of these, 70 of the 79 reported entanglements could be confirmed. Entanglements accounted for eight mortalities and six serious injuries. 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 frequency of entanglements.

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic humpback whales, January 2002 - December 2006. 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.

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Date[a]	Report Type[b]	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
2/08/02	mortality	Juvenile Female 8.4m	off Cape Henry, VA	P		3 large lacerations; hemorrhaging; broken bones
3/24/02	mortality	Juvenile Male 8.0m	off Virginia Beach, VA		P	Deep cuts on caudal peduncle and tail indicative of embedded line; no gear recovered
6/03/02	mortality	age & sex unknown 9.9m	off Cape Elizabeth, ME		P	Deep cuts on caudal peduncle indicative of embedded line; state water lobster fishery

6/17/02	serious injury	age & sex unknown 10.2m (est)	Cape Cod, MA		P	Fluke severely damaged by line; whale emaciated
8/01/02	mortality	Yearling Male 9.3m	Long Island, NY	P		Large hematoma posterior to blow holes
10/01/02	mortality	Calf Female 7.5m	Plymouth, MA		P	Found wrapped in line; extensive bruising; no gear recovered
6/06/03	mortality	Juvenile Female 8.3m	Chesapeake Bay mouth, VA	P		Major trauma to right side of head; hematoma
7/09/03	serious injury	Calf of Shockwave sex unknown	Bay of Fundy, NS		P	Constricting entanglement on a young whale; no gear recovered
7/12/03	serious injury	age & sex unknown	Oregon Inlet, NC		P	Entangled in substantial amount of gear; no gear recovered
8/15/03	mortality	Calf sex unknown 7.3m (est)	Petit Manan Island, ME		P	Floating offshore wrapped in line
8/16/03	serious injury	age & sex unknown	Cape Cod, MA		P	Poor body condition; line deeply embedded; gear recovered included sink gillnet, vessel anchoring system, surface buoy system and endline
8/18/03	serious injury	age & sex unknown	Cape Cod, MA		P	Extensive entanglement; no gear recovered
7/11/04	serious injury	Juvenile sex unknown "Lucky"	Briar Island, NS		P	Entanglement on a young whale
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
1/09/06	mortality	Adult Female #8667 14.0m	off Charleston, SC	P		Extensive muscle hemorrhaging; rib fractures; dislocated flipper on left side of animal
3/17/06	mortality	Juvenile Female 10.0m	Virginia Beach, VA	P		Crushed cranium and fractured mandible; hemorrhaging associated with fractures; ventral lacerations consistent with propeller wounds
3/25/06	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
8/06/06	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
8/20/06	mortality	age & sex unknown	East of Cape Cod, MA		P	Whale entangled through mouth continuing back to multiple wraps around peduncle. Resighted 9/6/06
8/23/06	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
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

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.

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic humpback whales, January 2001 - December 2005. 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]	Sex, age, ID length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
1/25/01	mortality	6.9m estimated	Avon, NC	P		extensive hemorrhaging along left thoracic, clean cut through center of vertebrae; ship strike
4/07/01	mortality	7.6m juvenile male	Emerald Isle, NC		P	entanglement around peduncle caused extensive edema, hemorrhaging, no gear recovered
4/08/01	mortality	7.9m juvenile male	Myrtle Beach, SC	S	P	pre-mortem evidence of chronic line entanglement; severe prop wounds, no gear recovered
4/09/01	mortality	8.8m juvenile female "Inland"	offshore of Sandbridge, Virginia Beach		P	found anchored in sink gillnet croaker fishery gear; line wraps around rostrum had immobilized the whale
7/29/01	mortality	8.5m juvenile female	floating south of Verrazano Bridge, NY	P		large laceration on left side of head, extensive fracturing of skull
10/01/01	mortality	11.4m 3 yr old female "Pitfall"	Duxbury Beach, MA	P		massive fracturing to skull, focal bruising indicative of pre-mortem ship strike
2/08/02	mortality	8.4m juvenile female	off Cape Henry, VA	P		three large lacerations, hemorrhaging, broken bones
3/24/02	mortality	8.0m juvenile male	off Virginia Beach, VA		P	deep cuts on caudal peduncle and tail indicative of embedded line, no gear recovered

6/03/02	mortality	9.9m	off Cape Elizabeth, ME		P	deep cuts on caudal peduncle indicative of embedded line, state water lobster fishery
6/17/02	serious injury	10.2m estimated	Cape Cod, MA		P	fluke severely damaged by line, whale emaciated
8/01/02	mortality	9.3m male	Long Island, NY	P		large hematoma posterior to blow holes
10/01/02	mortality	7.5m female calf	Plymouth, MA		P	found wrapped in line, extensive bruising, no gear recovered
6/06/03	mortality	8.3m female	Chesapeake Bay mouth, VA	P		major trauma to right side of head, hematoma
7/09/03	serious injury	calf of Shockwave	Bay of Fundy, Canada		P	constricting entanglement on a young whale, no gear recovered
7/12/03	serious injury	unknown	Oregon Inlet, NC		P	entangled in substantial amount of gear, no gear recovered
8/15/03	mortality	7.3m (est)calf	Petit Manan Island, ME		P	floating offshore wrapped in line
8/16/03	serious injury	unknown	Cape Cod, MA		P	poor body condition; line deeply embedded; gear recovered included sink gillnet, vessel anchoring system and surface buoy system and endline
8/18/03	serious injury	unknown	Cape Cod, MA		P	extensive entanglement, no gear recovered
7/11/04	serious injury	"Lucky" subadult	Briar Island, NS		P	entanglement on a young whale
10/03/04	mortality	15m (est) unknown	Georges Bank		P	fresh carcass with entangling line and high flyer; no gear recovered
12/19/04	mortality	8.0m calf	Bethany Beach, DE	P		hematoma and skeletal fracturing

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

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, but is a cause for concern.

In July 2003, another Unusual Mortality Event was recorded 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 tested 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 2006. Causes of these UME events have not been determined.

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, but is a cause for concern.

As reported by Wiley *et al.* (1995), injuries possibly attributable to ship strikes are more common and probably more serious than those from entanglements. In the NMFS records for 2001 through 2005, 12 records had some evidence of a collision with a vessel. Of these, 8 were mortalities as a result of the collision. The remaining incident occurred on 10/4/01 and involved a whale-watch vessel. Photos taken at the time of the collision confirmed that the injury was minor and follow-up documentation provided evidence that the injury had healed. 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 (Nelson *et al.* 2007).

STATUS OF STOCK

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 has been 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). As noted above, 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. In particular, the continued high level of mortality among humpback whales off the U.S. mid-Atlantic states (Barco *et al.* 2002) is a concern given that many of these animals are known to be from the Gulf of Maine. 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 assessment in preparation for a possible status review under the Endangered Species Act.

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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).

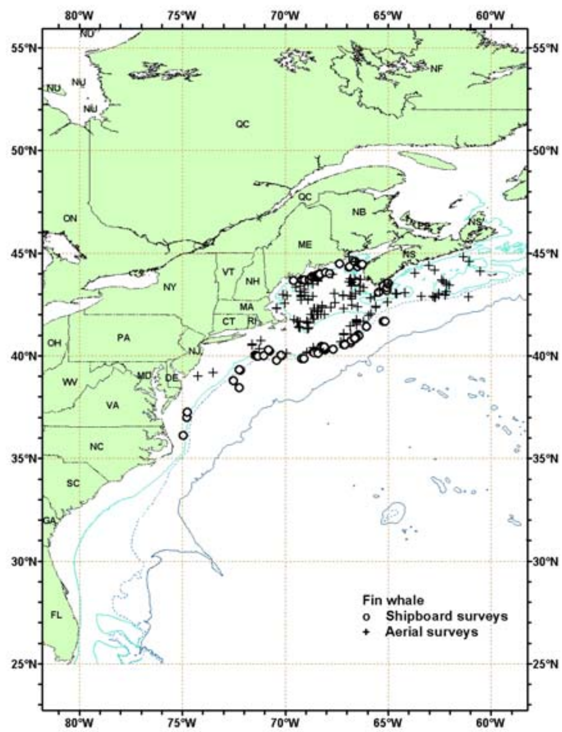

Figure 1. *Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

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 (Kenney *et al.* 1997; Hain *et al.* 1992).

There is little doubt that 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 2,269 (CV= 0.37). This August 2006 estimate is recent and provides an estimate when the largest portion of the population was within the study area. However, this estimate must be considered extremely conservative in view of the incomplete coverage of the known habitat of the stock and the uncertainties regarding population structure and whale movements between surveyed and unsurveyed areas. Estimates for animals identified as fin whales were ~~estimated~~ calculated separately from animals identified as either fin or sei whales. The final estimate of fin whales was the sum of the estimate of animals identified as fin whales plus a proportion of the estimate of animals identified as fin or sei whales, where the proportion was defined as the percent of fin whales out of the total number of positively identified fin whales and sei whales.

Earlier abundance estimates

An abundance of 2,200 (CV=0.24) fin whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane. The survey covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka 1995).

An estimate of abundance of 2,814 (CV=0.21) fin whales was derived from a 28 July to 31 August 1999 line-transect sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and for *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Palka 2000).

Recent surveys and abundance estimates

~~An estimate of abundance of 2,814 (CV=0.21) fin whales was derived from a 28 July to 31 August 1999 line-transect sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and for *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Palka 2000).~~

An abundance estimate of 2,933 (CV=0.49) 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 data of 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 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). The value of g(0) used for this estimation was derived from the pooled data of 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 2000m 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 data of 2002, 2004 and 2006 aerial survey data.

Table 1. Summary of recent abundance estimates for western North Atlantic fin whales. 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
~~Jul-Aug 1999~~	~~Georges Bank to mouth of Gulf of St. Lawrence~~	~~2,814~~	~~0.21~~
Aug 2002	S. Gulf of Maine to Maine	2,933	0.49
Jun-Jul 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

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 2,269 (CV=0.37). The minimum population estimate for the western North Atlantic fin whale is 1,678.

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 1,678. 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 3.4.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~2001~~ 2002 through ~~2005~~2006, the minimum annual rate of human-caused mortality and serious injury to fin whales was 2.~~4~~ 0 per year (U.S. waters, ~~1.8~~1.6; Canadian waters, 0.4~~; Bermudian waters, 0.2~~). This value includes incidental fishery interaction records, 0.8 (U.S. waters, 0.~~6~~8; Canadian waters, 0~~; Bermudian waters, 0.2~~); and records of vessel collisions, 1.~~6~~ 2 (U.S. waters, ~~1.2~~0.8; Canadian waters, 0.4) (~~Nelson~~ Glass *et al.* ~~2007~~2008). No ~~reported~~ fishery-related mortality or serious injury to fin whales was ~~observed~~ reported by NMFS fishery observers during ~~2001~~ 2002 through ~~2005~~2006.

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 ~~2001~~ 2002 through ~~2005~~ 2006 on file at NMFS found ~~three~~ two records with substantial evidence of fishery interactions causing mortality, and ~~one~~ two records resulting in serious injury (Table 2), which results in an annual rate of serious injury and mortality of 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. In addition to the records above, there are were ~~five~~ four additional records of entanglement within the period that either lacked substantial evidence for a serious injury determination, or did not provide the detail necessary to determine if an entanglement had been a contributing factor in the mortality.

Table 2. Confirmed human-caused mortality and serious injury records of western North Atlantic fin whales, January 2002 - December 2006.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
7/28/02	mortality	age & sex unknown	Georges Bank		P	Heavy line seen on tail stock; appeared embedded; no gear recovered
2/12/04	serious injury	age & sex unknown	Pea Island, NC		P	Entangled whale noticeably emaciated; no gear recovered
2/25/04	mortality	Adult Female 16.3m	Port Elizabeth, NJ	P		Displaced vertebrae; ruptured aorta
6/30/04	mortality	age & sex unknown 12m (est)	Georges Bank		P	Freshly dead; heavy line constricting mid-section; no gear recovered
9/26/04	mortality	age & sex unknown 15m (est)	St. Johns, NB	P		Fresh carcass on bow of ship
3/26/05	mortality	Adult[c] Female 16.3m	off Virginia Beach, VA	P		Extensive hemorrhaging and vertebral fractures
4/3/05	mortality	Adult[c] Female 18.8m	Southampton, NY	P		Subdermal hemorrhaging
8/23/05	mortality	Juvenile[c] Male 13.7m	Port Elizabeth, NJ	P		Brought in on bow of ship
9/11/05	mortality	Juvenile[c] Male 11m	Bonne Esperance, QC	P		Bottom jaw completely severed/broken
9/17/06	serious injury	age & sex unknown 18m (est)	off Mt. Desert Rock, ME		P	Pale skin overall; cyamid load at point of attachment; emaciated

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

Table 2. Confirmed human-caused mortality and serious injury records of western North Atlantic fin whales, January 2001 - December 2005.						
Date[a]	Report Type[b]	Sex, age, ID length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
1/2/01	mortality	18.1m female	New York harbor	P		dorsal abrasion marks, hematoma
2/1/01	mortality	14.5m female	Port Elizabeth, NJ	P		very fresh carcass hung on ship's bow
9/19/01	mortality	10.7m unknown	off Bermuda		P	extensive fresh entanglement marks; no gear recovered
7/28/02	mortality	unknown	Georges Bank		P	heavy line seen on tail stock, appeared embedded; no gear recovered
2/12/04	serious injury	unknown	Pea Island, NC		P	Entangled whale noticeably emaciated; no gear recovered
2/25/04	mortality	16.3m female	Port Elizabeth, NJ	P		Displaced vertebrae, ruptured aorta
6/30/04	mortality	12m est. unknown	Georges Bank		P	Fresh dead; heavy line constricting mid-section; no gear recovered
9/26/04	mortality	15m est. unknown	St. Johns, NB	P		Fresh carcass on bow of ship
3/26/05	mortality	11m male	off Virginia Beach, VA	P		Extensive hemorrhaging and vertebral fractures
4/3/05	mortality	13.7m male	Southampton, NY	P		Subdermal hemorrhaging
8/23/05	mortality	18.8m female	Port Elizabeth, NJ	P		Brought in on bow of ship
9/11/05	mortality	16.3m female	Bonne Esperance, QC	P		Bottom jaw completely severed/broken

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

After reviewing NMFS records for ~~2001~~ 2002 through ~~2005~~2006, eight were found that had sufficient information to confirm the cause of death as collisions with vessels (Table ~~1~~2) (~~Nelson~~ Glass *et al.* ~~2007~~2008).

These records constitute an annual rate of serious injury or mortality of 1.6 2 fin whales from vessel collisions. NMFS data include six three additional records of fin whale collisions with vessels, but the available supporting documentation is insufficient to determine if the whales sustained mortal injuries from the encounters. The number of fin whales taken at 3 whaling stations in Canada from 1965 to 1971 totaled 3,528 whales (Mitchell 1974). Reports of non-directed takes of fin whales are fewer over the last two decades than for other endangered large whales such as right and humpback whales.

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 Draft Recovery Plan for fin whales has been prepared and is available for review (NMFS 2006) ~~.~~.

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SEI WHALE (*Balaenoptera 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 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^{o} W.

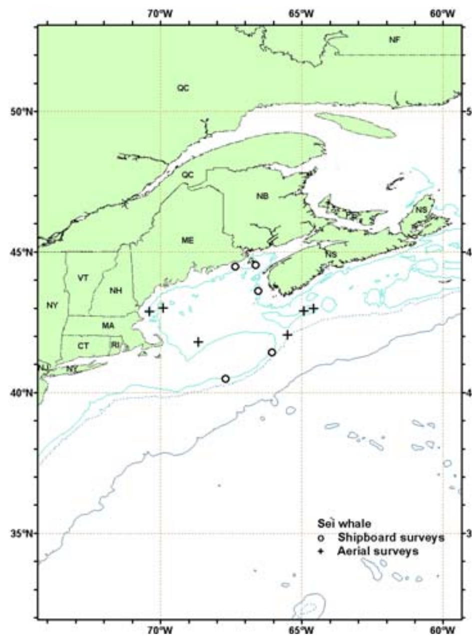

Figure 1. *Distribution of sei whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

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. The period of greatest abundance there is spring, 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 1999, 2000 and 2001 found concentrations of sei and right whales along the Northern 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, 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.

This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters. Although known to take piscine prey, sei whales (like right whales) are largely planktivorous, feeding primarily on euphausiids and copepods (Flinn *et al*. 2002). 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 1970's, 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 2006 abundance estimate (207) is considered the best available for the Nova Scotia stock of sei whales because it is the most recent. However, this estimate must be considered extremely 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. Estimates for animals identified as sei whales were generated independently from estimates of animals identified as either fin or sei whale. The final estimate of sei whales was the sum of the estimate of animals identified as sei whales and a portion of the estimate of animals identified as fin or sei whales, where the portion was defined as the percent of sei whales out of the total number of positively identified fin whales and sei whales.

Earlier abundance estimates

Mitchell and Chapman (1977), based on tag-recapture data, estimated the Nova Scotia, Canada, stock to contain between 1,393 and 2,248 sei whales. Based on census data, they estimated a minimum Nova Scotian population of 870 sei whales.

An abundance estimate of 280 sei whales was generated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). The estimate is based on data collected during the spring when the greatest proportion of the population off the northeast U.S. coast appeared in the study area. This estimate does not include a correction for dive-time or for g(0), the probability of detecting an animal group on the track line. The CETAP report suggested, however, that correcting the estimated abundance for dive time would increase the estimate to approximately the same as Mitchell and Chapman's (1977) tag-recapture estimate. This estimate is more than 20 years out of date and thus almost certainly does not reflect the current true population size; in addition, the estimate has a high degree of uncertainty (i.e., it has a large CV), and it was estimated just after cessation of extensive foreign fishing operations in the region. 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 data of 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). 6,180 km of trackline was within known sei whale habitat, 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. 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 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.)

Table 1. Summary of recent abundance estimates for Nova Scotia sei whales. 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). A current minimum population size is 128.

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 128. 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 0.3.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2002 through 2006, the minimum annual rate of human-caused mortality and serious injury to sei whales was 0.6 per year. This value includes incidental fishery interaction records, 0.2, and records of vessel collisions, 0.4 (Glass *et al.* 2008). ~~There was no reported fishery-related mortality or serious injury to sei whales in fisheries observed by NMFS during 2001-2005. A review of NMFS stranding and entanglement records from 2001 through 2005 yielded an average of 0.4 human-caused mortalities per year as a result of two ship strikes (Nelson *et al.* 2007). The carcass of a 13-meter female was recovered on May 2, 2001, in New York harbor after it slid off the bow of an arriving ship. Freshness of the carcass and hemorrhaging around the dorsal impact area indicated the strike was pre-mortem.~~ The ~~second~~ first ship-strike record within the period was an 11-meter male discovered 19 February ~~19,~~ 2003, outside of Norfolk Naval Base in Norfolk, ~~VA~~Virginia. A large gash into muscle tissue extended from behind dorsal midline on left side almost all the way around to the ventral midline on the right sides through blubber layer and into some muscle. Histopathology results supported perimortem trauma. Another ship-strike mortality was reported when a fresh sei whale carcass was brought in on the bow of a ship 17 April 2006 to Baltimore, M~~D~~aryland. The fishery entanglement mortality was discovered on Jeffreys Ledge on September 16, 2006. ~~The only other~~Previous NMFS records of ~~a~~ human-caused sei whale ~~mortality~~ mortalities include one~~was~~ from 17 November ~~17,~~ 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-meter female sei whale slid off the bow of a ship arriving in New York harbor. .

Fishery Information

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 2002 through 2006 on file at NMFS found one record with substantial evidence of fishery interactions causing mortality (Table 2), which results in an annual rate of serious injury and mortality of 0.2 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. ~~There have been no reported entanglements or other interactions between sei whales and commercial fishing activities; therefore there are no descriptions of fisheries.~~

Table 2. Confirmed human-caused mortality and serious injury records of Nova Scotian sei whales, 2002- 2006.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
2/19/03	mortality	age unknown Male 11.0m	Norfolk, VA	P		Large gash into muscle, hematoma and abrasions
4/17/06	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
9/16/06	mortality	age & sex unknown	Jeffreys Ledge		P	Constricting wrap cutting into skin; 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. 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.						

Table 2. Confirmed human-caused mortality and serious injury records of Nova Scotian sei whales, 2001–2005.

Date[a]	Report Type[b]	Sex, age, ID	Location[a]	Assigned Cause: P=primary, S=secondary		Notes / Observations
				Ship strike	Entang./ Fsh inter	
5/2/01	mortality	13.0 m female	New York Harbor	P		Fresh carcass hung on ship's bow; hemorrhaging
2/19/03	mortality	11.0m male	Norfolk, VA 36 58'N 76 21'W	P		Large gash into muscle, hemotoma 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. 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.						

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 level of U.S. fishery-caused mortality and serious injury is unknown, but the rarity of mortality reports for this species suggests that this level is insignificant and approaching a 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 sei whale is listed as an endangered species under the ESA. A Recovery Plan for sei whales has been written and is awaiting legal clearance.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Minke whales have a cosmopolitan distribution, being distributed in polar, 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 ~~eastern~~ 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 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. During fall in New England waters, 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 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.

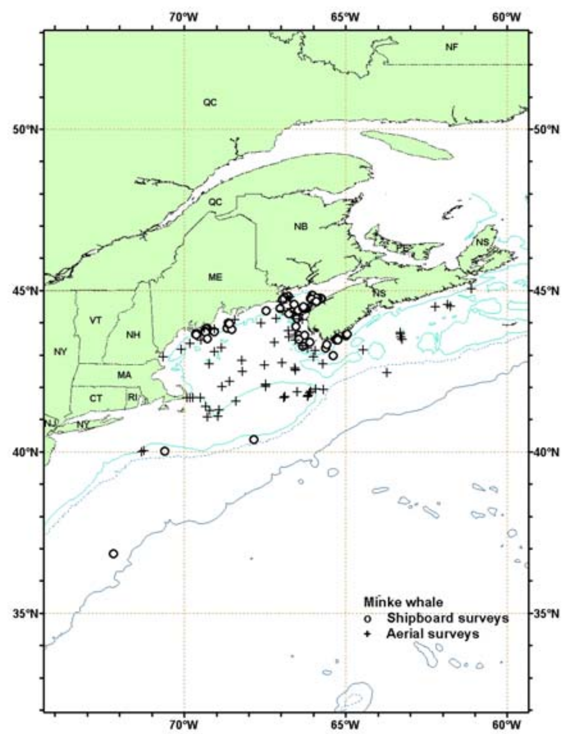

Figure 1. *Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

POPULATION SIZE

The total number of minke whales in the Canadian East Coast population is unknown. However, ten estimates are available for portions of the habitat: a 1978-1982 estimate; a shipboard survey estimate from the summers of 1991 and 1992; a shipboard estimate from June-July 1993; an estimate made from a combination of shipboard and aerial surveys conducted during July to September 1995; an aerial survey estimate of the entire Gulf of St. Lawrence conducted in August to September 1995; an aerial survey estimate from the northern Gulf of St. Lawrence conducted during July and August 1996; an aerial/shipboard survey conducted from Georges Bank to the mouth of the Gulf of St. Lawrence during July and August 1999; and aerial surveys conducted during the summers of 2002, 2004, and 2006 (Table 1; Figure 1). The best available current abundance estimate for minke whales, 3,312 (CV=0.74), is obtained from the 2006 aerial survey because this survey is recent and covered the largest portion of the animal's habitat.

Earlier estimates

An abundance estimate of 320 minke whales (CV=0.23) was derived from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 2,650 (CV=0.31) minke whales was obtained from two shipboard line-transect surveys conducted during July to September 1991 and 1992 in the northern Gulf of Maine-lower Bay of Fundy region. An abundance estimate of 330 minke whales (CV=0.66) was calculated from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993). An abundance estimate of 2,790 (CV=0.32) minke whales was obtained from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka 2006). Kingsley and Reeves (1998) estimated there were 1,020 (CV=0.27) minke whales in the entire Gulf of St. Lawrence in 1995 and 620 minke whales (CV=0.52) in the northern Gulf of St. Lawrence in 1996. During the 1995 survey, 8,427 km of track lines were flown in an area encompassing 221,949 km^2 in August - September. During the 1996 survey, 3,993 km of track lines were flown in an area encompassing 94,665 km^2 in July - August.

An abundance estimate of 2,998 (CV=0.19) minke whales was obtained from a July to August 1999 sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence (Table 1). Total track line length was 8,212 km. Using methods similar to the 1995 Virginia to Gulf of St. Lawrence survey, shipboard data were analyzed using the modified direct duplicate method that accounts for school size bias and *g(0)*. Aerial data were not corrected for *g(0)* (Palka 2000).

Recent surveys and abundance estimates

~~An abundance estimate of 2,998 (CV=0.19) minke whales was obtained from a July to August 1999 sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence (Table 1). Total track line length was 8,212 km. Using methods similar to the 1995 Virginia to Gulf of St. Lawrence survey, shipboard data were analyzed using the modified direct duplicate method that accounts for school size bias and *g(0)*. Aerial data were not corrected for *g(0)* (Palka 2000).~~

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 data of 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 100m 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; 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).

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.).

Table 1. Summary of abundance estimates for the Canadian east coast stock of minke whales. 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
~~July-Aug 1999~~	~~Georges Bank to mouth of Gulf of St. Lawrence~~	~~2,998~~	~~0.19~~
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

Table 1. Summary of abundance estimates for the Canadian east coast stock of minke whales. 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 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	3,312	0.74

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 3,312 animals (CV=0.74). The minimum population estimate for the Canadian East Coast minke whale is 1,899 animals.

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. Life history parameters that could be used to estimate net productivity are that females mature between 6-8 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 (Katona *et al.* 1993; IWC 1991).

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 1,899. 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 19.

ANNUAL HUMAN-CAUSED MORTALITY AND INJURY

Recent minke whale takes have been observed in—~~—~~or attributed to—~~—~~the Northeast bottom trawl, Northeast/Mid-Atlantic lobster trap/pot, and unknown fisheries, although not all takes have resulted in mortalities (Tables 2 to 6).

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 strandings and entanglement records considered confirmed human-caused mortalities or serious injuries are shown in Tables 3 through 5.

During ~~2001~~ 2002 to ~~2005~~2006, the U.S. total annual estimated average human-caused mortality was 2.~~6~~ 2 minke whales per year (CV=unknown), plus an unknown bycatch estimate from the Northeast bottom trawl fishery. This is derived from three components: an unknown number of minke whales per year from U.S. fisheries using observer data, ~~2.2~~1.8 minke whales per year (unknown CV) from U.S. fisheries using strandings and entanglement data, and 0.4 minke whales per year from ship strikes (~~Nelson~~ Glass *et al.* ~~2007~~2008). During 1997 to 2001, there were no confirmed mortalities or serious injuries in Canadian waters as reported by the various, small-scale stranding and observer data collection programs in Atlantic Canada. No additional information is available on Canadian mortalities from 2002 to present.

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 between 1989 and the present. The take in July 1991, south of Penobscot Bay, Maine resulted in 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.

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 maintained by the New England Aquarium and the Northeast Regional Office/NMFS, was taken in a 6-inch gill net on 6 July 1998 off Long Island, New York. This take was assigned to the mid-Atlantic gillnet fishery. No other minke whales have been taken in this fishery during observed trips in 1993 to ~~2005~~2006.

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 northeast tip of Georges Bank in US waters (Table 2). An expanded bycatch estimate has not been generated. With only one observed take, it is not possible to obtain an accurate bycatch estimate.

Northeast/Mid-Atlantic Lobster Trap/Pot Fishery

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported 7 minke whale mortalities and serious injuries that were attributed to the lobster fishery during 1990 to 1994; 1 in 1990 (may be 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 62FR33, 2 January ~~2,~~ 1997). The 1 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 4 confirmed 1997 records, 1 minke whale mortality was attributed to the lobster trap fishery. One minke whale was disentangled and released alive from lobster gear on 21 August 2002 (Table 4). One minke whale mortality was attributed to this fishery for 2002 (Tables 3 and 5). 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 this 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 to ~~2005~~2006. Estimated average annual mortality related to this fishery during ~~2001~~ 2002 to ~~2005~~ 2006 was 0.2 minke whales per year (Table 3; 10/15/02 animal in Table 5).

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. A review of these records is not complete. 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 5. Mortalities (and serious injuries) that were likely a result of a 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~~, and~~ 0 (0) in 2005 and 0 (0) in 2006. Examination of minke entanglement records from 1997 indicates that 4 out of 4 confirmed records of mortality were likely a result of fishery interactions. One was attributed to the lobster pot fishery (see above), and three were not attributed to any particular fishery because the information from the entanglement event often did not contain the necessary details. Of the five mortalities in 1999, two were attributed to an unknown trawl fishery and three to some other fishery. Of the two interactions with an unknown fishery in 2000, one was a mortality and one was a serious injury. In 2001, the two confirmed fishery interactions were both from an unknown fishery. In 2002, there was one mortality in an unknown fishery. In 2003, 4 of 5 confirmed mortalities were due to interactions with an unknown fishery. In 2004, of the three confirmed mortalities, two were due to an interaction with an unknown fishery (Tables 3 and 5). In 2005 and 2006 there were no mortalities attributed to fishery interactions.

In general, an entangled or stranded cetacean could be an animal that is part of an expanded bycatch estimate from an observed fishery and thus it is not possible to know if an entangled or stranded animal is an additional mortality. During 1997 to 2003 and in 2005-2006, no minke whales were observed taken in any fishery observed by the NEFSC Observer Program, therefore, the strandings from those years in which mortalities were attributable to fishery interactions can be added into the human-caused mortality estimate. During ~~2001~~ 2002 to ~~2005~~20065, as determined from strandings and entanglement records, the estimated average annual mortality is ~~2.0~~1.6 minke whales per year in unknown fisheries (Table 3).

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.).

Other Fisheries

Six minke whales were reported entangled during 1989 in the now non-operational groundfish gillnet fishery in Newfoundland and Labrador (Read 1994). One of these animals escaped and was still towing gear, the remaining 5 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 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). A total of 26 minkes have been reported entangled in fishing gear in Newfoundland for 2000 to 2006 (W. Ledwell, pers. comm.)

Table 2. Summary of the incidental mortality of minke whales (*Balaenoptera acutorostrata*) 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	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Bottom Trawl	~~01~~02-~~05~~06	unk	Obs. Data	~~.01,~~ .01, .03, .04, .05, .06	~~0,~~ 0, 0, 1, 0, 0	unk[c]	unk[c]	unk[c]

Table 2. Summary of the incidental mortality of minke whales (*Balaenoptera acutorostrata*) 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	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Total								unk[c]

a) Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Fisheries Science Center (NEFSC) Fisheries Observer Program.
b) Observer coverage for trawl fishery is measured in trips.
c) Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery has not been generated..

Table 3. From strandings and entanglement data, summary of confirmed incidental mortalities and serious injuries of minke whales (*Balaenoptera acutorostrata*) by commercial fishery: includes years sampled (Years), number of vessels active within the fishery (Vessels), type of data used (Data Type), mortalities and serious injuries assigned to this fishery (Assigned Mortality), and mean annual mortality and serious injuries. See Table 4 for details. (NA=Not Available)

Fishery	Years	Vessels	Data Type [a]	Assigned Mortality	Mean Annual Mortality
Northeast/Mid-Atlantic Lobster Trap/Pot	~~01~~02-~~05~~06	1997=6880 2000=7539 licenses	Entanglement & Strandings	~~0,~~ 1, 0, 0, 0, 0	0.2
Unknown Fisheries	~~01~~02-~~05~~06	NA	Entanglement & Strandings	~~2,~~ 1, 5, 2, 0, 0	~~2.0~~1.6
TOTAL					~~2.2~~1.8 (CV=unk)

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).

Table 4. Summary of minke whales (*Balaenoptera acutorostrata*) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured). (NA = Not Available)

Fishery	Years	Ratio	Injured	Uninjured
Lobster trap pot	None	NA	1[a]	0
Pelagic longline	~~01~~02-~~05~~06	0	0	1[b]

a. Minke whale disentangled and released alive from lobster gear by owner of gear on 21 August 2002 near Mount Desert Island, ME.
b. Minke whale released alive from pelagic longline gear in 2003.

Table 5. Summarized records of mortality and serious injury likely to result in mortality. Canadian East Coast stock of minke whales, January 2002 - December 2006. This listing includes only confirmed records related to U.S. commercial fisheries and/or ship strikes in U.S. waters. Causes of mortality or injury, assigned as primary or secondary, are based on records maintained by NMFS/NER and NMFS/SER.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	

7/17/02	mortality	Female, 4.6m (est)	Bar Harbor, ME (44º18.22'N 68º07.43'W)		P	Unknown fishery; carcass had a rope scar on the peduncle with associated hemorrhaging; additional bruising around the epiglottis and larynx; no gear recovered
10/15/02	mortality	Female, 5.1m	Gloucester, MA (42º36'N 70º39W)		P	Whale was entangled through the mouth and around the pectoral flippers; gear from state water lobster fishery was still on the whale
5/24/03	mortality	Male, 7.6m	Gloucester, MA (42º40.8'N 70º39.6'W)		P	Unknown fishery; line marks on head and dorsal fin; no line present; cut across back anterior to dorsal fin; no gear recovered
5/31/03	mortality	Female 3.6m (est)	Martha's Vineyard, MA (41º21.0'N 70º47.5'W)		P	Unknown fishery; whale stranded live wrapped in about 15 feet of 5.5 inch mesh netting, probably trawl gear
6/28/03	mortality	Male, 9.1m	Chatham, MA (41º40'N 69º55'W)		P	Lobster fishery; wrapped in lobster gear
8/9/03	mortality	Sub-adult Female, 3.5m (est)	Harwich, MA (41º37.3'N 70º03.0'W)		P	Unknown fishery; hemorrhaging in areas with net marks on whale; no gear recovered
9/13/03	mortality	Sub-adult Female, 6m (est)	Casco Bay, ME (43º42'N 69º58'W)		P	Unknown fishery; freshly dead; external chaffing marks and belly slit open; no gear recovered
5/6/04	mortality	Female, 7.7m	Martha's Vinyard, MA (41º21'N 70º40'W)		P	Unknown fishery; constricting line marks on peduncle; indications of drowning from internal exam
6/1/04	mortality	Female, 6.5m	Chatham, MA (41º 41'N 69º56'W)	P		Large area of subdermal hemorrhaging
7/19/04	mortality	Female, 7.9m	Eastham, MA (41º54'N 69º58'W)		P	Unknown fishery; extensive entanglement markings; no gear recovered

5/23/05	mortality	Sub-adult Male, 5.9m	Port Elizabeth, NJ (40° 41'N 74° 09'W)	P		Ribs shattered; liver ruptured; evidence of internal hemorrhaging

1. 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.
2. 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.

Table 5. Summarized records of mortality and serious injury likely to result in mortality. Canadian East Coast stock of minke whales, January 2001 - December 2005. This listing includes only confirmed records related to U.S. commercial fisheries and/or ship strikes in U.S. waters. Causes of mortality or injury, assigned as primary or secondary, are based on records maintained by NMFS/NER and NMFS/SER.

Date[a]	Report Type[b]	Sex, age, ID	Location[a]	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
8/17/01	mortality	male, 3.9m	Middletown, RI (41°28'N 71°15'W)		P	Unknown fishery. Severe rope entanglement around mouth and rostrum caused malnutrition and infection.
12/13/01	Mortality	unk sex, 7m (est)	Massachusetts Bay, MA (42°21'N 70°43'W)		P	Unknown fishery. Pictures show evidence of fairly fresh entanglement marks on tail stock and across tail flukes. No gear recovered.
7/17/02	Mortality	female, 4.6m (est)	Bar Harbor, ME (44°18.22'N 68°07.43'W)		P	Unknown fishery. Carcass had a rope scar on the peduncle with associated hemorrhaging. Additional bruising around the epiglottis and larynx. No gear recovered.
10/15/02	Mortality	female, 5.1m	Gloucester, MA (42°36'N 70°39W)		P	Whale was entangled through the mouth and around the pectoral flippers. Gear from state water lobster fishery was still on the whale.

5/24/03	Mortality	male, 7.6m	Gloucester, MA (42º40.8'N 70º39.6'W)		P	Unknown fishery. Line marks on head and dorsal fin, no line present. Cut across back anterior to dorsal fin. No gear recovered.
5/31/03	Mortality	Female 3.6m (est)	Martha's Vineyard, MA (41º21.0'N 70º47.5'W)		P	Unknown fishery. Whale stranded live wrapped in about 15 feet of 5.5 inch mesh netting, probably trawl gear.
6/28/03	Mortality	male, 9.1m	Chatham, MA (41º40'N 69º55'W)		P	Lobster fishery. Wrapped in lobster gear.
8/9/03	Mortality	sub-adult female, 3.5m (est)	Harwich, MA (41º37.3'N 70º03.0'W)		P	Unknown fishery. Hemorrhaging in areas with net marks on whale. No gear recovered.
9/13/03	Mortality	Sub-adult female, 6m (est)	Casco Bay, ME (43º42'N 69º58'W)		P	Unknown fishery. Fresh dead. External chaffing marks and belly slit open. No gear recovered.
5/6/04	Mortality	female, 7.7m	Martha's Vineyard, MA (41º21'N 70º40'W)		P	Unknown fishery. Constricting line marks on peduncle. Indications of drowning from internal exam.
6/1/04	Mortality	female, 6.5m	Chatham, MA (41º 41'N 69º56'W)	P		Ship strike. Large area of subdermal hemorrhaging.
7/19/04	Mortality	female, 7.9m	Eastham, MA (41º54'N 69º58'W)		P	Unknown fishery. Extensive entanglement markings. No gear recovered.
5/23/05	Mortality	5.9m male subadult	Port Elizabeth, NJ (40º 41'N 74º 09'W)	P		Ribs shattered, liver ruptured, evidence of internal 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.

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 at low levels.

U.S.

Minke whales inhabit coastal waters during much of the year and are 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 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 ~~contributed~~ attributed to ~~a~~ ship strike in each year (Table 5). During 2006, no minke whale was confirmed struck by a ship. Thus, during 200~~1~~2 to 200~~5~~6, as determined from stranding and entanglement records, the estimated 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. Two of the seven criteria established to designate such an event were met by these species. Specifically, there was a marked increase in mortalities when compared with historical records, and the mortalities were occurring in a localized area of the Maine coast. From 11-30 September ~~11-30,~~ 2003, nine minke whales were reported along the mid-coast to southern Maine. Results from analyses for biotoxins failed to show the presence of either saxitoxin or domoic acid (by ELISA and Receptor Binding Assay). Most whale carcasses that were examined appeared to be in good body condition immediately prior to death. Since October 2003, 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 (~~Nelson~~ Glass *et al.* ~~2007~~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. Ne of the stranding mortalities from New Jersey was reported with signs of human interaction due to pieces of plastic found in the stomach.

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 Dept. 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 ~~2005~~ 2006 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 6): 4 minke whales stranded in 1997 (1 in June and 3 in July), 0 documented strandings in 1998 to 2000, 1 in September 2001, 4 in 2002 (1 in July, 1 in August, and 2 in November), 2 in 2003 (1 in August and 1 in October), 0 in 2004 ~~and~~, 3 in 2005 (1 in June and 2 in August), and 8 in 2006 (1in January, 2 in May, 1 in July, 1 in August, 1 in Nov (live) and 2 in December).

The Whale Release and Strandings program has reported nine minke whale stranding mortalities in Newfoundland and Labrador between 2001 and 2006 (Ledwell and Huntington 2001, 2001, 2002, 2003, 2004, 2006, 2007)

Table 6. Documented number of stranded minke whales along the Atlantic coast of ~~Nova Scotia~~ Canada during ~~2001~~ 2002 to ~~2005~~ 2006 by year, according to records maintained by the Canadian Marine Animal Response Society and the Whale Release and Strandings Program.

Area	YEAR					
	~~2001~~2002	~~2002~~2003	~~2003~~2004	~~2004~~2005	~~2005~~2006	Total
Nova Scotia	~~1~~4	~~4~~3	~~3~~0	~~0~~3	~~3~~8	~~11~~18

Newfoundland and Labrador	1	1	2	1	1	6
Total	5	4	2	4	9	24

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 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 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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NORTHERN BOTTLENOSE WHALE (*Hyperoodon ampullatus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern bottlenose whales are characterized as extremely uncommon or rare in waters of the U.S. Atlantic Exclusive Economic Zone. The two sightings of three individuals constituted less than 0.1% of the 11,156 cetacean sightings in the 1978-82 CETAP surveys. Both sightings were in the spring, along the 2,000 m isobath (CETAP 1982). In 1993 and 1996, two sightings of single animals, and in 1996, a single sighting of six animals (one juvenile), were made during summer shipboard surveys conducted along the southern edge of Georges Bank (NMFS 1993; NMFS 1996).

Northern bottlenose whales are distributed in the North Atlantic from Nova Scotia to about 70º in the Davis Strait, along the east coast of Greenland to 77º and from England to the west coast of Spitzbergen. It is largely a deep-water species and is very seldom found in waters less than 2,000 m deep (Mead 1989).

There are two main centers of bottlenose whale distribution in the western north Atlantic, one in the area called "The Gully" just north of Sable Island, Nova Scotia, and the other in Davis Strait off northern Labrador (Reeves *et al*. 1993). Studies at the entrance to the Gully from 1988-1995 identified 237 individuals and estimated the local population size at about 230 animals (95% C.I. 160-360) (Whitehead *et al*. 1997). Wimmer and Whitehead (2004) identified individuals moving between several Scotian Shelf canyons more than 100 km from the Gully. Whitehead and Wimmer (2005) estimated a population of 163 animals (95% confidence interval 119-214), with no statistical significant population trend. These individuals are believed to be year-round residents and all age and sex classes are present (Gowans and Whitehead 1998; Gowans *et al.* 2000; Hooker *et al.* 2002). Mitchell and Kozicki (1975) ~~documented~~ reported stranding records in the Bay of Fundy and as far south as Rhode Island. Lucas and Hooker (2000) documented three stranded individuals on Sable Island, Nova Scotia, Canada.

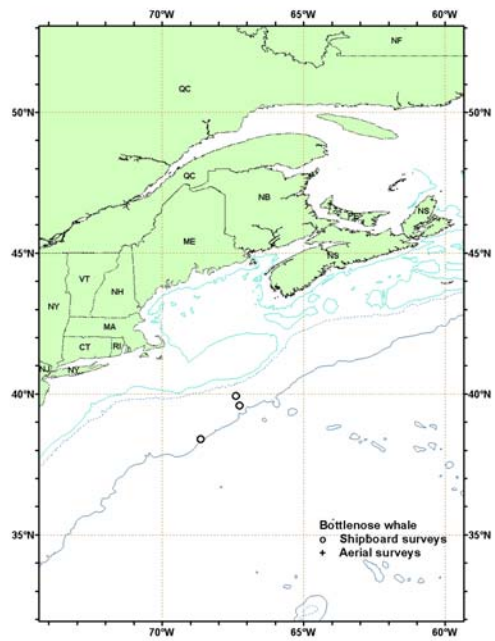

Figure 1: *NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

Several genetic studies have been undertaken in the waters off Nova Scotia (Dalebout *et al.* 2001; 2006; Hooker *et al.* 2001a, 2001b, 2002). Dalebout (*et al.* 2006) found distinct differences in the nuclear and mitochondrial markers for the small populations of bottlenose whales of the Gully, Labrador and Iceland. Stock definition is currently unknown for those individuals inhabiting/visiting U.S. waters.

POPULATION SIZE

The total number of northern bottlenose whales off the eastern U.S. coast is unknown.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

Current Population Trend

There are insufficient data to determine the 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 unknown. 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 this stock is of unknown status. PBR for the western North Atlantic northern bottlenose whale is unknown because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY

No mortalities have been reported in U.S. waters. A fishery for northern bottlenose whales existed in Canadian waters during both the 1800s and 1900s. Its development was due to the discovery that bottlenose whales contained spermaceti. A Norwegian fishery expanded from east to west (Labrador and Newfoundland) in several episodes. The fishery peaked in 1965. Decreasing catches led to the cessation of the fishery in the 1970s, and provided evidence that the population was depleted. A small fishery operated by Canadian whalers from Nova Scotia operated in the Gully, and took 87 animals from 1962 to 1967 (Mead 1989; Mitchell 1977).

Fishery Information

The only documented fishery interaction with northern bottlenose whales occurred in 2001 in the U.S. NED experimental pelagic longline fishery in Canadian waters. The animal was released alive, but considered a serious injury (Garrison 2003).

Other Mortality

In 2006, two northern bottlenose whales stranded alive in Delaware Bay. This mother calf pair was first reported stranded in New Jersey, where volunteers pushed them off the beach. The two animals restranded in Delaware, The calf was encouraged back into the water and was last seem swimming, but the mother stranded dead.~~where they were subsequently died~~. This is believed to be the southern most U.S. stranding record for this species.

STATUS OF STOCK

The status of northern bottlenose whales relative to OSP in U.S. Atlantic EEZ is unknown; however, ~~a~~ the depletion in Canadian waters in the 1970's may have impacted U.S. distribution and may be relevant to current status in U.S. waters. The Canadian Scotian Shelf population was designated by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as of Special Concern. Its status was uplisted to Endangered in November 2002, based on its small population estimate and the potential threat posed by oil and gas development in and around the population's prime habitat. This population was legally listed under the Species at Risk Act in 2006 (COSEWIC 2002; DFO 2007). Thise species is not listed as threatened or endangered under the U.S. Endangered Species Act. There are insufficient data to determine population trends for this species. The total level of U.S. fishery-caused mortality and serious injury is unknown. Because this stock has a marginal occurrence in U.S. waters and there are no documented takes in U.S. waters, this stock has been designated as not strategic.

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CUVIER'S BEAKED WHALE (*Ziphius cavirostris*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of Cuvier's beaked whales is poorly known, and is based mainly on stranding records (Leatherwood *et al.* 1976). Strandings have been reported from Nova Scotia along the eastern U.S. coast south to Florida, around the Gulf of Mexico, and within the Caribbean (Leatherwood *et al.* 1976; CETAP 1982; Heyning 1989; Houston 1990; Mignucci-Giannoni *et al.* 1999; MacLeod *et al.* 2006). Stock structure in the North Atlantic is unknown.

Cuvier's beaked whale sightings have occurred principally along the continental shelf edge in the Mid-Atlantic region off the northeast U.S. coast (CETAP 1982; Waring *et al.* 1992; Waring *et al.* 2001; Hamazaki 2002; Palka 2006). Most sightings were in late spring or summer.

POPULATION SIZE

The total number of Cuvier's beaked whales off the eastern U.S. and Canadian Atlantic coast is unknown.

However, several estimates of the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) from selected regions are available for select time periods (Barlow *et al*. 2006). Sightings are almost exclusively in the continental shelf edge and continental slope areas (Figure 1). The best abundance estimate for beaked whales is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 3,513 (CV =0.63), where the estimate from the northern U.S. Atlantic is 2,839 (CV =0.578), and from the southern U.S. Atlantic is 674 (CV =0.36). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.

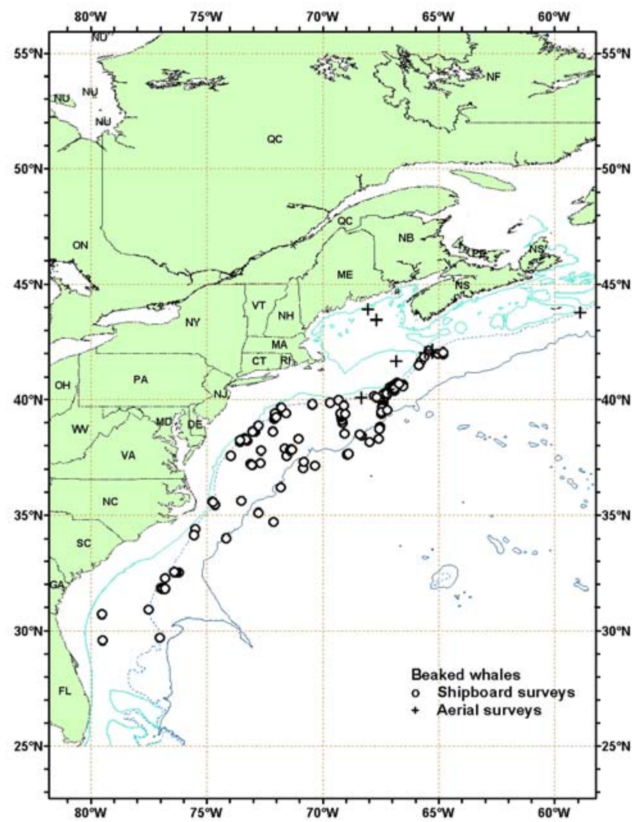

Figure 1. *Distribution of beaked whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer 1998, 1999, 2002, 2004 and 2006. Isobaths are 100 m. 1.000 m. and 4.000 m.*

Earlier abundance estimates

An abundance of 120 undifferentiated beaked whales (CV=0.71) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 442 (CV=0.51) undifferentiated beaked whales was obtained from an August 1990 shipboard line-transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (NMFS 1990; Waring *et al.* 1992). An abundance estimate of 262 (CV=0.99) undifferentiated beaked whales was obtained from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundance estimates of 370 (CV=0.65) and 612 (CV=0.73) undifferentiated beaked whales were obtained from line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11aircraft (NMFS 1991). An abundance of 330 (CV=0.66) undifferentiated beaked whales was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993). An abundance of 99 (CV=0.64) undifferentiated beaked whales was estimated from an August 1994 shipboard line transect survey conducted within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank (NMFS 1994). An abundance of 1,519 (CV=0.69) undifferentiated beaked whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence

(Palka 2006). An abundance estimate of 3,141 (CV=0.34) undifferentiated beaked whales was obtained from the sum of the estimate of 2,600 undifferentiated beaked whales (CV=0.40) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 541 (CV = 0.55) undifferentiated beaked whales, obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). 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. 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 822 (CV=0.81) undifferentiated beaked 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 data of 2002, 2004 and 2006 aerial survey data.

An abundance of 2,211 (CV=0.58) for beaked whales was estimated 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 (38^0N) to the Bay of Fundy (45^0N) (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 50x 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). The resulting abundance estimate for beaked whales between Florida and Maryland was 674 animals (CV =0.36*)*.

An abundance estimate of 922 (CV=1.47) undifferentiated beaked 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.)

Although the 1990-2006 surveys did not sample exactly the same areas or encompass the entire beaked whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-2004 data suggest that, seasonally, at least several thousand beaked whales are occupying these waters, with highest levels of abundance in the Georges Bank region. Recent results suggest that beaked whale abundance may be highest in association with Gulf Stream and warm-core ring features.

Because the estimates presented here were not dive-time corrected, they are likely negatively biased and probably underestimate actual abundance. Given that *Mesoplodon* spp. prefers deep-water habitats (Mead 1989) the bias may be substantial.

Table 1. Summary of abundance estimates for the undifferentiated complex of beaked whales which include *Ziphius* and *Mesoplodon* spp. 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	822	0.81
Jun-Aug 2004	Maryland to the Bay of Fundy	2,839	0.78

Jun-Aug 2004	Florida to Maryland	674	0.36
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	3,513	0.63
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	922	1.47

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 undifferentiated beaked whales is 3,513 (CV =0.63). The minimum population estimate for the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 2,154. It is not possible to determine the minimum population estimate of only Cuvier's beaked whales.

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. Life history parameters that could be used to estimate net productivity include: length at birth is 2 to 3 m, length at sexual maturity is 6.1m for females, and 5.5 m for males, maximum age for females were 30 growth layer groups (GLG's) and for males was 36 GLG's, which may be annual layers (Mitchell 1975; Mead 1984; Houston 1990).

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 the undifferentiated complex of beaked whales is 2,154. 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 0.4 because the CV for the fishery mortality estimate exceeds 0.8. PBR for all species in the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 17. It is not possible to determine the PBR for only Cuvier's beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The ~~2001~~2002-~~2005~~ 2006 total average estimated annual mortality of beaked whales in fisheries in the U.S. Atlantic EEZ was 1.0 and is derived from ~~five~~ four components: 1) average annual fishery bycatch of one animal (Table 2), one stranded animal entangled in fishing gear, 3) two animals that were ship struck, ~~4) one stranded animal died from acoustic or blunt trauma,~~ and ~~5~~4) one animal with ingested debris - see other mortality text and Table 2.

Fishery Information

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

Total annual estimated average fishery related mortality or serious injury of this stock in ~~2001~~2002-~~2005~~ 2006 in the U.S. fisheries listed below was 1 beaked whale (CV=1.0). Detailed fishery information is reported in Appendix III.

Earlier Interactions

There is no historical information available that documents incidental mortality of beaked whales in either U.S. or Canadian Atlantic coast fisheries (Read 1994). The only documented bycatch prior to 2003 of beaked whales is in the pelagic drift gillnet fishery (now prohibited). The bycatch only occurred from Georges Canyon to Hydrographer Canyon along the continental shelf break and continental slope during July to October. Forty-six fishery-related beaked whale mortalities were observed between 1989 and 1998. These included 24 Sowerby's, 4 True's, 1 Cuvier's and 17 undifferentiated beaked whales. Recent analyses of biological samples (genetics and morphological analysis) have been used to determine species identifications for some of the bycaught animals. Estimated bycatch mortality by species is available for the 1994-1998 period. Prior estimates are for undifferentiated beaked whales. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.21), 76 in 1990 (0.26), 13 in 1991 (0.21), 9.7 in 1992 (0.24) and 12 in 1993 (0.16). The 1994-1998 estimates by 'species' are:

Year	**Cuvier's**	**Sowerby's**	**True's**	***Mesoplodon* spp.**
1994	1 (0.14)	3 (0.09)	0	0
1995	0	6 (0)	1 (0)	3 (0)
1996	0	9 (0.12)	2 (0.26)	2 (0.25)
1997	NA	NA	NA	NA
1998	0	2 (0)	2 (0)	7 (0)

During July 1996, one beaked whale was entangled and released alive with "gear in/around a single body part". Annual mortality estimates do not include any animals injured and released alive.

Pelagic Longline

One unidentified beaked whale was seriously injured in the U.S. Atlantic pelagic longline fishery in 2003. This interaction occurred in the Sargasso Sea fishing area. The estimated fishery-related combined mortality in 2003 was 5.3 beaked whales (CV=1.0). No serious injury or mortality interactions were reported prior to 2003 or in ~~2004~~ 2005-2006~~or 2005~~. The estimated average combined mortality in ~~2001~~2002-~~2005~~ 2006 was 1 beaked whale (CV=1.0)(Table 2).

Table 2. Summary of the incidental mortality of Beaked Whales (*Ziphius cavirostris* and *Mesoplodon* sp.) 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 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	Vessels[c]	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 (excluding NED-E) [b,d]	~~01~~02-~~05~~06	~~98,~~ 87, 63, 60, 60, 63	Obs. Data Logbook	~~.04,~~ .05, .09, .09, .06, .07	~~0,~~ 0, 1, 0, 0, 0	0, 0, 0, 0, 0	~~0,~~ 0, 5.3[e], 0, 0, 0	0, 0, 0, 0, 0	~~0,~~ 0, 5.3, 0, 0, 0	~~0,~~ 0, 1.0, 0, 0, 0	1(1.0)
TOTAL											1 (1.0)

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 2003 SI estimates were taken from Table 10 in Garrison and Richards (2004).

c Number of vessels in the fishery are based on vessels reporting effort to the pelagic longline logbook.

Other Mortality

From 1992 to 2000, a total of 53 beaked whales stranded along the U.S. Atlantic coast between Florida and Massachusetts (NMFS unpublished data). This includes: 28 (includes one tentative identification) Gervais' beaked whales (one 1997 animal had plastics in esophagus and stomach, and Sargassum in esophagus; 2 animals that stranded in September 1998 in South Carolina showed signs of fishery interactions); 2 True's beaked whales; 5 Blainville's beaked whales; 1 Sowerby's beaked whale; 13 Cuvier's beaked whales (one 1996 animal had propeller marks, and one 2000 animal had a longline hook in the lower jaw) and 4 unidentified animals.

One stranding of Sowerby's beaked whale was recorded on Sable Island between 1970-1998 (Lucas and Hooker 2000). The whale's body was marked by wounds made by the cookiecutter shark (*Isistius brasiliensis*), which has previously been observed on beaked whales (Lucas and Hooker 2000).

Also, several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with Naval activities. During the mid- to late 1980's multiple mass strandings of Cuvier’s beaked whales (4 to about 20 per event) and small numbers of Gervais’ beaked whale and Blainville’s beaked whale occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier’s beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 were associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier’s and 1 Blainville’s) died (Balcomb and Claridge 2001;NMFS 2001; Cox *et al*. 2006). Four Cuvier’s, 2 Blainville’s and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown, since none of the whales have been resighted. Necropsies of 6 dead beaked whales revealed evidence of tissue trauma associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (Cox *et al.* 2006).

During ~~2001~~2002-~~2005~~2006, ~~thirty-four~~twenty-eight beaked whales stranded along the U.S. Atlantic coast and Puerto Rico (Table 2).

Table 2. Beaked whale (*Ziphius cavirostris* and *Mesoplodon* sp.) strandings along the U.S. Atlantic coast.

State	2001	2002	2003	2004	2005	Total
Maine	-	*M. mirus* (1)	*M. bidens* (1)[c]	-	-	2
Massachusetts	-	-	-	-	-	0
New Jersey	-	-	-	-	*Ziphius* (1)	1
Virginia	0	*M. Europaeus* (2)[b]	*M. mirus* (1)[d]	-	-	3
North Carolina	*M. europaeus* (1) Mesoplodon sp. (3)	Unid. (1)	*M. europeaus* (2); *Mesoplodon* sp. (1)	- *M. densirostris* (1)	*M. europeaus* (2); *M. densirostris* (1)	- 12
South Carolina	*M. europaeus* (2)	*Ziphius* (1)	*Ziphius* (2)	-	*M. densirostris* (1)	6
Georgia				*M. bidens* (1)	*Ziphius* (1)[f]	2
Florida	*M. europaeus* (4)[a]	–	*Ziphius* (1); *M. europeaus* (1)	- *M. europeaus* (1);	- *Mesoplodon sp.* (1)	7
Puerto Rico				*M. densirostris* (1)		1
Total	10	5	9	4	7	34[e]

[a] Acoustic or blunt trauma was the assigned cause of mortality for one animal stranded in Broward County in Sept.

[b] Ship strike was the likely cause of death for one animal

[c] Boat strike was the likely cause of death

[d] Entanglement in fishing gear was the likely cause of death

[e] The cause of death for most of the stranded animals could not be determined.

[f] Plastic debris found in the stomach.

Table 2. Beaked whale (*Ziphius cavirostris* and *Mesoplodon* sp.) strandings along the U.S. Atlantic coast.

State	2002	2003	2004	2005	2006	Total
Maine	*M. mirus* (1)	*M. bidens* (1)[b]	_	_	_	2
Massachusetts	_	_	_	_	*Ziphius* (1)	1
New Jersey	_	_	_	*Ziphius* (1)	_	1
Virginia	*M. Europaeus* (2)[a]	*M. mirus* (1)[c]	_	_	_	3
North Carolina	Unid. (1)	*M. europeaus* (2); *Mesoplodon* sp. (1)	_ *M. densirostris (1)*	*M. europeaus* (2); *M. densirostris (1)*	_ *M. densirostris (1)*	- 9
South Carolina	*Ziphius* (1)	*Ziphius* (2)	_	*M. densirostris (1)*	_	4
Georgia	_		*M. bidens* (1)	*Ziphius* (1)[e]	*Ziphius* (1)	3
Florida	--	*Ziphius* (1); *M. europaeus* (1)	_ *M. europeaus* (1);	_ *Mesoplodon sp. (1)*	_ _	4
Puerto Rico	_	_	*M. densirostris (1)*	_	_	1
Total	5	9	4	7	3	28[d]

[a] Ship strike was the likely cause of death for one animal

[b] Boat strike was the likely cause of death

[c] Entanglement in fishing gear was the likely cause of death

[d] The cause of death for most of the stranded animals could not be determined.

[e] Plastic debris found in the stomach.

STATUS OF STOCK

The status of Cuvier's beaked whale relative to OSP in the U.S. Atlantic EEZ is unknown. This species is not listed as threatened or endangered under the Endangered Species Act. Although a species specific PBR cannot be determined, the permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality. The total U.S. fishery mortality and serious injury for this group 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 of uncertainty regarding stock size and evidence of human induced mortality and serious injury associated with acoustic activities~~ because average annual human-related mortality and serious injury does not exceed PBR.

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MESOPLODON BEAKED WHALES (*Mesoplodon* spp.): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the genus *Mesoplodon*, there are four species of beaked whales that reside in the northwest Atlantic. These include True's beaked whale, *Mesoplodon mirus*; Gervais' beaked whale, *M. europaeus*; Blainville's beaked whale, *M. densirostris*; and Sowerby's beaked whale, *M. bidens* (Mead 1989). These species are difficult to identify to the species level at sea; therefore, much of the available characterization for beaked whales is to genus level only. Stock structure for each species is unknown.

The distribution of *Mesoplodon* spp. in the northwest Atlantic is known principally from stranding records (Mead 1989; Nawojchik 1994; Mignucci-Giannoni *et al.* 1999; MacLeod *et al*. 2006). Off the U.S. Atlantic coast, beaked whale (*Mesoplodon* spp.) sightings have occurred principally along the shelf-edge and deeper oceanic waters (CETAP, 1982; Waring *et al.* 1992; Tove 1995; Waring *et al*. 2001; Hamazaki 2002; Palka 2006; Figure 1)). Most sightings were in late spring and summer, which corresponds to survey effort.

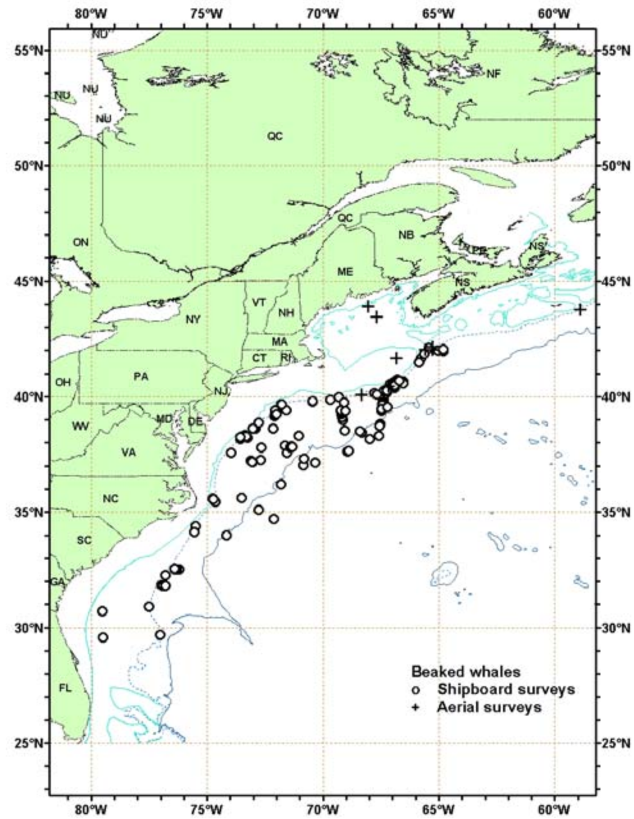

Figure 1: *NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

True's beaked whale is a temperate-water species that has been reported from Cape Breton Island, Nova Scotia, to the Bahamas (Leatherwood *et al.* 1976; Mead 1989; MacLeod *et al.* 2006). It is considered rare in Canadian waters (Houston 1990).

Gervais' beaked whales are believed to be principally oceanic, and strandings have been reported from Cape Cod Bay to Florida, into the Caribbean and the Gulf of Mexico (Leatherwood *et al.* 1976; Mead 1989; MacLeod *et al.* 2006; NMFS unpublished data). This is the most common species of *Mesoplodon* to strand along the U.S. Atlantic coast. The northernmost stranding was on Cape Cod.

Blainville's beaked whales have been reported from southwestern Nova Scotia to Florida, and are believed to be widely but sparsely distributed in tropical to warm-temperate waters (Leatherwood *et al.* 1976; Mead 1989, Nicolas *et al.* 1993 ;MacLeod *et al.* 2006). There are two records of strandings in Nova Scotia which probably represent strays from the Gulf Stream (Mead 1989). They are considered rare in Canadian waters (Houston 1990).

Sowerby's beaked whales have been reported from New England waters north to the ice pack, and individuals are seen along the Newfoundland coast in summer (Leatherwood *et al.* 1976; Mead 1989; MacLeod *et al.* 2006). Furthermore, a single stranding occurred off the Florida west coast (Mead 1989). This species is considered rare in Canadian waters (Lien *et al.* 1990).

POPULATION SIZE

The total number of *Mesoplodon* spp. beaked whales off the eastern U.S. and Canadian Atlantic coast is unknown. However, several estimates of the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) from selected regions are available for select time periods (Barlow *et al.* 2006). Sightings are almost exclusively in the continental shelf edge and continental slope areas (Figure 1). The best abundance estimate for beaked whales is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 3,513 (CV =0.63), where the estimate from the northern U.S. Atlantic is 2,839 (CV =0.578), and from the southern U.S. Atlantic is 674 (CV =0.36). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 120 (CV=0.71) undifferentiated beaked whales was obtained from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 442 (CV=0.51) undifferentiated beaked whales was obtained from an August 1990 shipboard line-transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (NMFS 1990; Waring *et al.* 1992). An abundance of 262 (CV=0.99) undifferentiated beaked whales was estimated from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundance estimates of 370 (CV=0.65) and 612 (CV=0.73) undifferentiated beaked whales were obtained from line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11aircraft (NMFS 1991). An abundance of 330 (CV=0.66) undifferentiated beaked whales was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993). An abundance of 99 (CV=0.64) undifferentiated beaked whales was estimated from an August 1994 shipboard line transect survey conducted within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank (NMFS 1994). An abundance of 1,519 (CV=0.69) undifferentiated beaked whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka 2006). An abundance estimate of 3,141 (CV=0.34) undifferentiated beaked whales was obtained from the sum of the estimate of 2,600 undifferentiated beaked whales (CV=0.40) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 541 (CV = 0.55) undifferentiated beaked whales, obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). 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. 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 822 (CV=0.81) undifferentiated beaked 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 data of 2002, 2004 and 2006 aerial survey data.

An abundance of 2,211 (CV=0.58) for beaked whales was estimated from a line transect sighting survey conducted during June 12 to August 4, 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 > 50m) between Florida and Maryland (27.5 and 38ºN latitude) was conducted during June-August, 2004. The survey employed two independent visual teams searching with 50x 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). The resulting abundance estimate for beaked whales between Florida and Maryland was 674 animals (CV =0.36).

An abundance estimate of 922 (CV=1.47) undifferentiated beaked 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.)

Although the 1990-2006 surveys did not sample exactly the same areas or encompass the entire beaked whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-2004 data suggest that, seasonally, at least several thousand beaked whales are occupying these waters, with highest levels of abundance in the Georges Bank region. Recent results suggest that beaked whale abundance may be highest in association with Gulf Stream and warm-core ring features.

Because the estimates presented here were not dive-time corrected, they are likely negatively biased and probably underestimate actual abundance. Given that *Mesoplodon* spp. prefers deep-water habitats (Mead 1989) the bias may be substantial.

Table 1. Summary of abundance estimates for the undifferentiated complex of beaked whales which include *Ziphius* and *Mesoplodon* spp. 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	Georges Bank to Maine coast	822	0.81
Jun-Aug 2004	Maryland to the Bay of Fundy	2,839	0.78
Jun-Aug 2004	Florida to Maryland	674	0.36
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	3,513	0.63
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	922	1.47

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 undifferentiated beaked whales is 3,513 (CV =0.63). The minimum population estimate for the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 2,154. It is not possible to determine the minimum population estimate of only *Mesoplodon* beaked whales.

Current Population Trend

There are insufficient data to determine population trends for these 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: length at birth is 2 to 3m, length at sexual maturity 6.1m for females, and 5.5m for males, maximum age for females were 30 growth layer groups (GLG's) and for males was 36 GLG's, which may be annual layers (Mead 1984).

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 the undifferentiated complex of beaked whales is 2,154. 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 0.4 because the CV for the fishery mortality estimate exceeds 0.8. PBR for all species in the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 17. It is not possible to determine the PBR for only *Mesoplodon* beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The ~~2001~~2002-~~2005~~ 2006 total average estimated annual mortality of beaked whales in fisheries in the U.S. Atlantic EEZ is 1.0 and is derived from five components: 1) average annual fishery bycatch of one animal (Table 2), one stranded animal entangled in fishing gear, 3) two animals that were ship struck, ~~4) one stranded animal died from acoustic or blunt trauma,~~ and ~~5~~4) one animal with ingested debris - see other mortality text and Table 2.

Fishery Information

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

Estimated annual average fishery-related mortality or serious injury of this stock in ~~2001~~2002-~~2005~~ 2006 in the U.S.

fisheries listed below was 1 beaked whale (CV=1.0)(Table 1). Detailed fishery information is reported in Appendix III.

Earlier Interactions

There is no historical information available that documents incidental mortality in either U.S. or Canadian Atlantic coast fisheries (Read 1994). The only documented bycatch prior to 2003 of beaked whales is in the pelagic drift gillnet fishery (now prohibited). The bycatch only occurred from Georges Canyon to Hydrographer Canyon along the continental shelf break and continental slope during July to October (Northridge 1996). Forty-six fishery-related beaked whale mortalities were observed between 1989 and 1998. These included: 24 Sowerby's; 4 True's; 1 Cuvier's; and 17 undifferentiated beaked whales. Recent analysis of biological samples (genetics and morphological analysis) has been used to determine species identifications for some of the bycaught animals. Estimates of bycatch mortality by species are available for the 1994-1998 period. Prior estimates are for undifferentiated beaked whales. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.21), 76 in 1990 (0.26), 13 in 1991 (0.21), 9.7 in 1992 (0.24) and 12 in 1993 (0.16). The 1994-1998 estimates by 'species' are:

Year	**Cuvier's**	**Sowerby's**	**True's**	***Mesoplodon* spp.**
1994	1 (0.14)	3 (0.09)	0	0
1995	0	6 (0)	1 (0)	3 (0)
1996	0	9 (0.12)	2 (0.26)	2 (0.25)
1997	NA	NA	NA	NA
1998	0	2 (0)	2 (0)	7 (0)

During July 1996, one beaked whale was entangled and released alive with "gear in/around a single body part". Annual mortality estimates do not include any animals injured and released alive.

Pelagic Longline

One unidentified beaked whale was seriously injured in the U.S. Atlantic pelagic longline fishery in 2003. This interaction occurred in the Sargasso Sea fishing area. The estimated fishery-related combined mortality in 2003 was 5.3 beaked whales (CV=1.0). No serious injury or mortality interactions were reported prior to 2003 or in 2004 ~~or 2005~~- 2006. The estimated average combined mortality in ~~2001~~2002-~~2005~~ 2006 was 1 beaked whale (CV=1.0)(Table 2).

Table 2. Summary of the incidental mortality of Beaked Whales (*Ziphius cavirostris* and *Mesoplodon* sp.) 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 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	Vessels[c]	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 (excluding NED-E)[b,d]	~~01~~02-~~05~~06	~~98,~~ 87, 63, 60, 60, 63	Obs. Data Logbook	.04, .05, .09, .09, .06, .07	~~0,~~ 0, 1, 0, 0, 0	0, 0, 0, 0, 0	~~0,~~ 0, 5.3[e], 0, 0, 0	0, 0, 0, 0, 0	~~0,~~ 0, 5.3, 0, 0, 0	~~0,~~ 0, 1.0, 0, 0, 0	1(1.0)
TOTAL											1 (1.0)

[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] 2003 SI estimates were taken from Table 10 in Garrison and Richards (2004).
[c] Number of vessels in the fishery are based on vessels reporting effort to the pelagic longline logbook.

Other Mortality

From 1992-2000, a total of 53 beaked whales stranded along the U.S. Atlantic coast between Florida and Massachusetts (NMFS unpublished data). This includes: 28 (includes one tentative identification) Gervais' beaked whales (one 1997 animal had plastics in esophagus and stomach, and Sargassum in esophagus; 2 animals that stranded in September 1998 in South Carolina showed signs of fishery interactions); 2 True's beaked whales; 5 Blainville's beaked whales; 1 Sowerby's beaked whale; 13 Cuvier's beaked whales (one 1996 animal had propeller marks, and one 2000 animal had a longline hook in the lower jaw) and 4 unidentified animals. One stranding of Sowerby's beaked whale was recorded on Sable Island between 1970-1998 (Lucas and Hooker 2000). The whale's body was marked by wounds made by the cookiecutter shark (*Isistius brasiliensis*), which has previously been observed on beaked whales (Lucas and Hooker 2000).

Also, several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with naval activities. During the mid- to late 1980's multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whale and Blainville's beaked whale occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 was associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Balcomb and Claridge 2001; NMFS 2001; Cox *et al*.2006). Four Cuvier's, 2 Blainville's , and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown, since none of the whales have been resighted. Necropsy of 6 dead beaked whales revealed evidence of tissue trauma associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (Cox *et al*.,2006).

During ~~2001~~2002-~~2005~~2005, ~~thirty-four~~twenty-eight beaked whales stranded along the U.S. Atlantic coast and Puerto Rico (Table 2).

~~Table 2. Beaked whale (*Ziphius cavirostris* and *Mesoplodon* sp.) strandings along the U.S. Atlantic coast.~~

~~State~~	~~2001~~	~~2002~~	~~2003~~	~~2004~~	~~2005~~	~~Total~~
~~Maine~~	-	~~*M. mirus* (1)~~	~~*M. bidens* (1)~~[c]	-	-	~~2~~
~~Massachusetts~~	-	-	-	-	-	~~0~~
~~New Jersey~~	-	-	-	-	~~*Ziphius* (1)~~	~~1~~
~~Virginia~~	~~0~~	~~*M. Europaeus* (2)~~[b]	~~*M. mirus* (1)~~[d]	-	-	~~3~~
~~North Carolina~~	~~*M. europaeus* (1)~~ ~~Mesoplodon sp. (3)~~	~~Unid. (1)~~	~~*M. europeaus* (2);~~ ~~*Mesoplodon* sp. (1)~~	- ~~*M. densirostris* (1)~~	~~*M. europeaus* (2);~~ ~~*M. densirostris* (1)~~	- ~~12~~
~~South Carolina~~	~~*M. europaeus* (2)~~	~~*Ziphius* (1)~~	~~*Ziphius* (2)~~	-	~~*M. densirostris* (1)~~	~~6~~

~~Georgia~~				~~*M. bidens* (1)~~	~~*Ziphius* (1)[f]~~	~~2~~
~~Florida~~	~~*M. europaeus* (4)[a]~~	~~--~~	~~*Ziphius* (1);~~ ~~*M. europaeus* (1)~~	- ~~*M. europeaus* (1);~~	- ~~*Mesoplodon sp.* (1)~~	~~7~~
~~Puerto Rico~~				~~*M. densirostris* (1)~~		~~1~~
~~Total~~	~~10~~	~~5~~	~~9~~	~~4~~	~~7~~	~~34[e]~~

~~[a] Acoustic or blunt trauma was the assigned cause of mortality for one animal stranded in Broward County in Sept.~~

~~[b] Ship strike was the likely cause of death for one animal~~

~~[c] Boat strike was the likely cause of death~~

~~[d] Entanglement in fishing gear was the likely cause of death~~

~~[e] The cause of death for most of the stranded animals could not be determined.~~

~~[f] Plastic debris found in the stomach.~~

Table 2. Beaked whale (*Ziphius cavirostris* and *Mesoplodon* sp.) strandings along the U.S. Atlantic coast.

State	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
Maine	*M. mirus* (1)	*M. bidens* (1)[b]	_	_	_	2
Massachusetts	_	_	_	_	*Ziphius* (1)	1
New Jersey	_	_	_	*Ziphius* (1)	_	1
Virginia	*M. Europaeus* (2)[a]	*M. mirus* (1)[c]	_	_	_	3
North Carolina	Unid. (1)	*M. europeaus* (2); *Mesoplodon* sp. (1)	_ *M. densirostris* (1)	*M. europeaus* (2); *M. densirostris* (1)	_ *M. densirostris* (1)	_ 9
South Carolina	*Ziphius* (1)	*Ziphius* (2)	_	*M. densirostris* (1)	_	4
Georgia	_		*M. bidens* (1)	*Ziphius* (1)[e]	*Ziphius* (1)	3
Florida	--	*Ziphius* (1);	_	_	_	4

		M. europaeus (1)	*M. europeaus* (1);	*Mesoplodon sp.* (1)	_	
Puerto Rico	_	_	*M. densirostris* (1)	_	_	1
Total	5	9	4	7	3	28 [d]

[a] Ship strike was the likely cause of death for one animal

[b] Boat strike was the likely cause of death

[c] Entanglement in fishing gear was the likely cause of death

[d] The cause of death for most of the stranded animals could not be determined.

[e] Plastic debris found in the stomach.

STATUS OF STOCK

The status of *Mesoplodon* beaked whales relative to OSP in U.S. Atlantic EEZ is unknown. These species are not listed as threatened or endangered under the Endangered Species Act. Although a species specific PBR cannot be determined, the permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality. The total U.S. fishery mortality and serious injury for this group 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 average annual human-related mortality and serious injury does not exceed PBR. ~~because of uncertainty regarding stock size and evidence of human induced mortality and serious injury associated with acoustic activities.~~

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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 northeast 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; Waring 1993). 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 2006). The Gulf of Mexico and Atlantic stocks are currently being treated as two separate stocks.

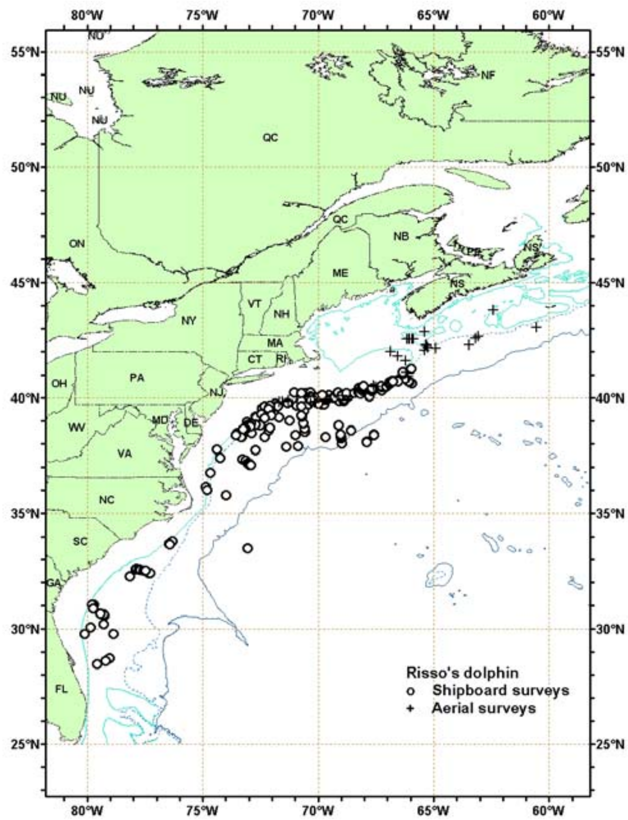

Figure 1. *Distribution of Risso's dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the ~~summesr~~ summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100 m, 1,000 m, and 4,000 m depth contours.*

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 the 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

An abundance estimate of 4,980 Risso's dolphins (CV=0.34) was obtained from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 11,017 (CV=0.58) Risso's dolphins was obtained from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundance estimates of 6,496 (CV=0.74) and 16,818 (CV=0.52) Risso's dolphins were obtained from line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11 aircraft (NMFS 1991). An abundance estimate of 212 (CV=0.62) Risso's dolphins was obtained from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993). A 1995 abundance estimate of 5,587 (CV=1.16) Risso's dolphins was obtained from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence. An abundance estimate of 28,164 (CV=0.29) Risso's dolphins was obtained from the sum of the estimate of 18,631 (CV=0.35) Risso's dolphins from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 9,533 (CV=0.50) Risso's dolphins, estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). 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 ~~6~~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 data of 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 10,761km 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 > 50m) between Florida and Maryland (27.5 and 38ºN latitude) was conducted during June-August 2004. The survey employed two independent visual teams searching with ~~50x~~ 25x bigeye binocul~~u~~ars. 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 ~~accomplisheda~~ 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 data of 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.~~5~~ 48 because the CV of the average mortality estimate is between~~less than~~ 0.3 an d0.6 (Wade and Angliss 1997). PBR for the western North Atlantic stock of Risso's dolphin is 124~~9~~.

ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality or serious injury to this stock during ~~2001~~2002-~~2005~~ 2006 was ~~40~~ 25 Risso's dolphins (CV=0.~~28~~32); 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 northeast coast of the U.S. With implementation of the ~~Magnuson-Stevens~~ Fisheries Conservation and Management Act ~~(MS-FCMA)~~ in that year, an observer program was established which recorded fishery data and information on incidental bycatch of marine mammals. NMFS foreign-fishery observers have 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). ~~Three animals were taken by squid trawlers and a single animal was killed in longline fishing operations.~~

In the pelagic drift gillnet fishery fifty-one 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, 9 in 1998 (0).

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).

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 and 2002, 2003, 2004 and 2005 were obtained from Garrison (2003), Garrison and Richards (2004), Garrison (2005), and Fairfield-Walsh and Garrison (2006). 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 2005 were, respectively, 2, 0, 6, 4, 1, 0, 1, 1, 1, 6, 4, 2, 2, and 0 (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, and Fairfield-Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007) (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 ~~2005~~ 2006 (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, ~~and~~ 3(1.0) and 0 in 2005 (Table 2). The annual average combined mortality and serious injury for ~~2001~~2002-~~2005~~ 2006 is ~~34~~ 20 Risso's dolphins (CV =0.~~32~~38; 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, ~~and~~ 15 in 2005 (0.93), and 0 in 2006 (Table 2). The ~~2001~~2002-~~2005~~ 2006 average mortality in this fishery is 3 Risso's dolphins (CV =0.93).

Table 2. Summary of the incidental mortality of Risso's dolphin (*Grampus griseus*) 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 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	Vessels[b]	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 (excluding NED-E) [c]	~~01~~02-~~05~~06	~~98,~~ 87, 63, 60, 60, 63	Obs. Data Logbook	~~.04,~~ .05, .09, .09, .06, .07	~~6,~~ 4, 2, 2, 0, 0	~~1,~~ 0, 0, 0, 0, 0	~~45,~~ 8, 40, 28, 3, 0	~~24,~~ 20[d], 0, 0, 0, 0	~~69,~~ 28, 40, 28, 3, 0	~~.57,~~ .67, .63, .72, 1, 0	~~34~~20(0.3~~2~~8)
Pelagic Longline - NED-E area only [c]	~~01~~02-03	~~9,~~ 14, 11	Obs. Data Logbook	~~1,~~ 1, 1	~~4,~~ 3, 0	~~0,~~ 0, 1	~~4,~~ 3, 0	~~0,~~ 0, 1	~~4,~~ 3, 1	~~0,~~ 0, 0	~~3~~2
Northeast Sink Gillnet	~~01~~02-~~05~~06	1993=349 1998=301	Obs. Data Weighout Trip Logbook	~~.04,~~ .02, .03, .06, .07, .04	0, 0, 0, 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	3 (0.93)
TOTAL											~~40~~ 25 (0.~~28~~32)

[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] Number of vessels in the fishery are based on vessels reporting effort to the pelagic longline logbook.

[c] An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001-December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row (Garrison 2003; Garrison and Richards 2004) The NED area was reopened in June 2004, so '04 ~~and~~ - ~~'05~~ '06 bycatch analysis includes this area.

[d] Note that the 2002 estimate of Risso's dolphin mortality is estimated from observed mortality rates in previous years (1998-2002) due to a gap in coverage during the 3rd quarter of 2002.

Other mortality

From ~~2001~~2002~~-~~ to~~2005~~2006, ~~65 58~~77 Risso's dolphin strandings were recorded along the U.S. Atlantic coast (NMFS unpublished data). Six animals during this time period had indications of human interaction, three of which were fishery interactions. In eastern Canada, one Risso's dolphin stranding was reported on Sable Island, Nova Scotia from 1970-1998 (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

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, 2002-2006.

STATE	2002	2003	2004	2005	2006	TOTALS
Maine	0	0	2	0	1	3
New Hampshire	0	0	0	0	0	0
Massachusetts[ad]	5	~~0~~10	4	8	1	~~1~~28
Rhode Island	0	0	1	1	0	2
Connecticut	0	0	0	0	0	0
New York	1	0	3	4	1	9
New Jersey	0	0	0	5	0	5
Delaware	0	0	1	1	0	2
Maryland	1	~~0~~2	1	2	1	~~5~~7
Virginia[b]	0	~~0~~1	1	4	1	~~6~~7
North Carolina[c]	2	1	2	2	1	8
South Carolina	0	0	0	0	0	0
Georgia	0	0	0	0	0	0
Florida	1	1	3	0	0	5
EZ	0	0	1	0	0	1
TOTAL	10	~~2~~15	19	27	6	~~58~~77

a. One of the 2004 animals was mutilated, fluke cut off.
b. One of the 2005 animals showed signs of ~~human~~fishery interaction.
c. One of the 2006 animals showed signs of fishery interaction.
d. 2003 includes 8 animals mass stranded in M~~A~~assachusetts, 3 of which were released alive.

Table 3. Risso's dolphin (*Grampus griseus*) reported strandings along the U.S. Atlantic coast, 2001-2005.						
STATE	**2001**	**2002**	**2003**	**2004**	**2005**	**TOTALS**
Maine	0	0	0	2	0	**2**
New Hampshire	0	0	0	0	0	**0**
Massachusetts [a]	1	5	0	4	8	**18**
Rhode Island	0	0	0	1	1	**2**
Connecticut	0	0	0	0	0	**0**
New York	0	1	0	3	4	**8**
New Jersey	0	0	0	0	5	**5**
Delaware	0	0	0	1	1	**2**
Maryland	1	1	0	1	2	**5**
Virginia [b]	1	0	0	1	4	**6**
North Carolina	3	2	1	2	2	**10**
South Carolina	0	0	0	0	0	**0**
Georgia	0	0	0	0	0	**0**
Florida	1	1	1	3	0	**6**
EZ	0	0	0	1	0	**1**
TOTAL	**7**	**10**	**2**	**19**	**27**	**65**
a. 2001 animal had signs of human interaction, and one of the 2004 animals was mutilated, fluke cut off. b. One of the 2005 animals was showed signs of human interaction.						

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, can not be considered to be insignificant and approaching a zero mortality and serious injury rate. The 20012002-2005 2006 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*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of pilot whales in the western Atlantic——the Atlantic or long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea; therefore, some of the descriptive material below refers to *Globicephala* sp., and is identified as such. The species is considered to occur from Canada to Cape Hatteras. NMFS is currently conducting research to improve the understanding of species delineation and distribution.

Pilot whales (*Globicephala* sp.) are distributed principally along the continental shelf edge off the northeast 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).

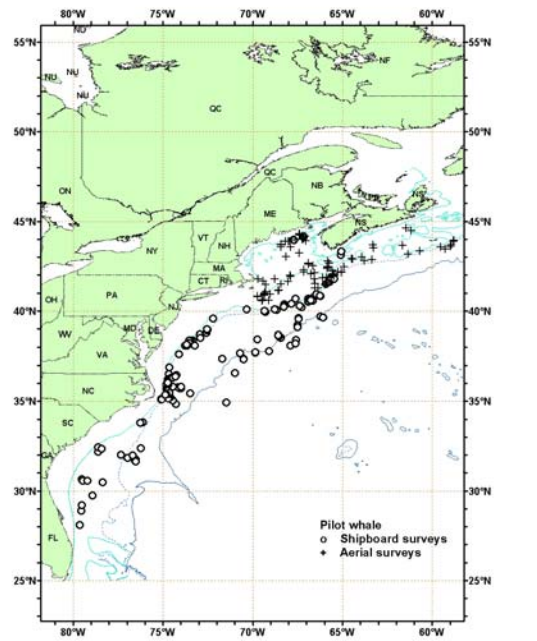

Figure 1. *Distribution of pilot whales sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are at the 100 m, 1,000 m, and 4,000 m depth contours.*

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). ~~Recent m~~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.

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. Sightings were almost exclusively in the continental shelf edge and continental slope areas (Figure 1). Because long-finned and short-finned pilot whales are difficult to distinguish at sea, seasonal abundance estimates are reported for *Globicephala* sp., both long-finned and short-finned pilot whales. The best abundance estimate for *Globicephala* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys. This joint estimate (15,728 + 15,411 = 31,139 whales) is considered best because these two surveys together have the most complete coverage of the species' habitat.

Earlier estimates

Mitchell (1974) used cumulative catch data from the 1951-1961 drive fishery off Newfoundland to estimate the initial population size (ca. 50,000 animals). Mercer (1975) used population models to estimate a population in the same region of between 43,000 and 96,000 long-finned pilot whales, with a range of 50,000-60,000. An abundance estimate of 11,120 (CV=0.29) *Globicephala* sp. was obtained from an aerial survey program conducted from 1978 to 1982 in continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 3,636 (CV=0.36) *Globicephala* sp. was obtained from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundances estimates of 3,368 (CV=0.28) and 5,377 (CV=0.53) *Globicephala* sp. were derived from line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11 aircrafts (NMFS 1991). An abundance estimate of 668 (CV=0.55) *Globicephala* sp. was obtained from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993a). A 1995 abundance estimate of 9,776 (CV=0.55) *Globicephala* sp. was generated from the sum of the estimates of 8,176 (CV=0.65) *Globicephala* sp. from the U.S. July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence, and 1,600 (CV=0.65) *Globicephala* sp. from Canadian aerial surveys in late August and early September in the Gulf of St. Lawrence in 1995 and 1998 (Kingsley and Reeves 1998). An abundance estimate of 14,909 (CV = 0.26) *Globicephala* sp. was obtained from the sum of the estimate of 9,800 *Globicephala* sp. (CV=0.34) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 5,109 (CV = 0.41) *Globicephala* sp., obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable and should not be used for PBR determinations. 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

An abundance estimate of 5,408 (CV=0.56) *Globicephala* sp. 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), the probability of detecting a group on the track line used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

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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 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>50m) between Florida and Maryland (27.5 ºN and 38ºN latitude) was conducted during June-August 2004. The survey employed two independent visual teams searching with 50x 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). The resulting abundance estimate for *Globicephala* sp. between Florida and Maryland was 15,411 animals (CV =0.43).

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.)

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	15,411	0.43
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	31,139	0.27
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	26,535	0.35

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 *Globicephala* sp. is 31,139 animals (CV = 0.27) derived from the 2004 surveys. The minimum population estimate for *Globicephala* sp. is 24,866.

Current Population Trend

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

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 ~~is~~ of 177 cm; mean length at sexual maturity ~~is~~ of 490 cm for males and 356 cm for females; age at sexual maturity ~~is~~ of 12 years for males and 6 years for females; mean adult length ~~is~~ of 557 cm for males and 448 cm for females; and maximum age ~~was~~ 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 *Globicephala* sp. is 24,866. 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 *Globicephala* sp. is 249. It is not possible to determine the PBR for only long-finned pilot whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2002-2006 was

165 pilot whales (CV=0.14); Table 2).

Fishery Information

Detailed fishery information is reported in Appendix III.

Total fishery-related mortality and serious injury cannot be estimated separately for the two 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 northeast 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 Magnuson-Stevens Fisheries Conservation and Management Act (M-SFCMA).

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).

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 one interaction, the net was actually pursed around one 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 n No marine mammals were observed taken during these trips.

No pilot whales were taken in observed mid-Atlantic Coastal Gillnet trips during 1993-1997. One pilot whale was observed taken in 1998, 0 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 (CV in parentheses) attributed to this fishery was 7 (CV=1.10) in 1998 (1.10).

One pilot whale take was observed in the *Illex* squid portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish 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 New England/Mid-Atlantic Squid, Mackerel, Butterfish 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 is has been included as a component of the mid-Atlantic bottom trawl fishery.

There was one observed take in the Southern New England/mid-Atlantic Bottom 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 is 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 earlier fishery interactions see Waring *et al.* 2007.

Pelagic Longline

Most of the estimated marine mammal bycatch ~~is~~ was from U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999; Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006, 2007). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and ~~2005~~ 2006 ~~109~~ 128 pilot whales (including 2 identified as short-finned pilot whales) were released alive, including ~~61~~ 73 that were considered seriously injured (of which 1 was identified as a short-finned pilot whale), and ~~4~~ 5 mortalities were observed (Johnson *et al.* 1999; Yeung 2001; Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006, 2007). 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 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 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 2003-2004. 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~~ including 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) ~~and~~, 212 (CV=0.21) in 2005, and 169 (CV=0.47) in 2006. The average 'combined' annual mortality in ~~2001~~2002-~~2005~~ 2006 was ~~86~~ 109 pilot whales (CV=0.~~16~~20) (Table 2).

An experimental fishery was conducted on six vessels operating in the Gulf of Mexico and off the U.S. east coast in 2005, with 100% observer coverage achieved during this experimental fishery. During this experiment, different hook baiting techniques 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 one which 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, ~~and~~ four in 2005, and one in 2006. 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, ~~and~~ 31 (CV=0.31) in 2005, and 37 (CV=0.34) in 2006. The ~~2001~~2002-~~2005~~ 2006 average mortality attributed to the Mid-Atlantic bottom trawl was ~~38~~ 34 animals (CV=0.15).

Northeast Bottom Trawl

Two pilot whales were observed taken in the Northeast bottom trawl in 2004 ~~and~~, four in 2005, and one in 2006. 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, ~~and~~ 15 (CV=0.30) in 2005, and 14 (0.28) in 2006. The ~~2001~~2002-~~2005~~ 2006 average mortality attributed to the northeast bottom trawl was ~~19~~ 15 animals (CV=0.~~12~~13).

~~**GOM/GB Herring Mid-Water Trawl JV and TALFF**~~

~~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) (Table 2). The 2001-2005 average mortality attributed to the Atlantic herring mid-water trawl fishery was 11 animals (Table 2).~~

Northeast Mid-Water Trawl – Including Pair Trawl

The observer coverage in this fishery was highest after 2003, though a few trips in earlier years were observed (Table 2). A pilot whale was observed taken in the single trawl fishery on the northern edge of Georges Bank (off of Massachusetts) in a haul that was targeting (and primarily caught) herring in 2004. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 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, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities ~~(CV in parentheses)~~ were: unknown in 2001-2002, 1.9 (CV=0.56) in 2003, and 1.4 (CV=0.58) in 2004, ~~and~~ 1.1(CV=0.68) in 2005, and 0 in 2006 (Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during ~~2001~~2002-~~2005~~2006 was 1 (CV=0.35).

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

The observer coverage in this fishery was highest after 2003, though a few trips in other years were observed (Table 2). No pilot whales were observed bycaught in this fishery between ~~2001~~2002-~~2005~~2006, though because of data pooling, estimates were still generated. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 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, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities ~~(CV in parentheses)~~ were unknown in ~~2001-~~2002, 3.9 (CV=0.46) in 2003, 8.1 (CV=0.38) in 2004, ~~and~~ 7.5 (CV=0.76) in 2005, and 0 in 2006 (Table 2; Palka pers. com.). The average annual estimated fishery-related mortality during ~~2001~~2002-~~2005~~ 2006 was ~~7~~ 5 (CV=0.34).

CANADA

An unknown number of 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 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 100ft), 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 one record of incidental catch in the offshore Greenland halibut fishery that involved one long-finned pilot whale in 2001; no expanded bycatch estimate was calculated (Benjamins *et al.* in press).

Table 2. Summary of the incidental mortality and serious injury of pilot whales (*Globicephala sp.*) 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 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	Vessels[a]	Data Type[b]	Observer Coverage[c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Bottom Trawl[d]	02-06	unk	Obs. Data Dealer	.01, .01, .03, .03, .02	0, 0, 0, 0, 0	0, 0, 0, 4, 1	0, 0, 0, 0, 0	38, 31, 35, 31, 37	38, 31, 35, 31, 37	.36, .31, .33, .31, .34	34 (.15)
Northeast Bottom Trawl[d]	02-06	unk	Obs. Data Dealer Data VTR Data	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	0, 0, 0, 2, 4, 1	0, 0, 0, 0, 0	22, 20, 15, 15, 14	22, 20, 15, 15, 14	.26, .26, .29, .30, .28	15 (.13)
Mid-Altlantic Mid-Water Trawl - Including Pair Trawl[e]	02-06	20, 23, 25, 31, ??	Obs. Data Dealer Data VTR Data	.003, .018, .064, .084, .089	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk, 3.9, 8.1, 7.5, 0	unk, 3.9, 8.1, 7.5, 0	unk, .46, .38, .76, 0	5 (.34)
Northeast Mid-Water Trawl - Including Pair Trawl[e]	02-06	27, 28, 22, 25, ??	Obs. Data Dealer Data VTR Data	0, .031, .126, .199, .031	0, 0, 0, 0, 0	0, 0, 1, 0, 0	0, 0, 0, 0, 0	unk, 1.9, 1.4, 1.1, 0	unk, 1.9, 1.4, 1.1, 0	unk, .56, .58, .68, 0	1 (.35)
Pelagic Longline (excluding NED-E)[f]	02-06	87, 63, 60, 60, 63	Obs. Data Logbook	.05, .09, .09, .06, .07	4, 2, 6, 9, 12	0, 0, 0, 0, 1	52, 21, 74, 212, 169	2, 0, 0, 0, 16	54, 21, 74, 212, 185	.46, .77, .42, .21, .47	109 (.20)
Pelagic Longline - NED-E area only[f]	02-03	14, 11	Obs. Data Logbook	1, 1	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0	0
2005 Pelagic Longline experimental fishery[g]	05	6	Obs. Data	1	1	0	1	0	1	na	1(na)
TOTAL											165 (.14)

a. Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.

b. 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).

c. 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.

d. A new method was used to develop estimates of mortality for the Mid-Atlantic and Northeast bottom trawl fisheries during 2000-2006. 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 during 2000-2006. NE and MA bottom trawl mortality estimates reported for 2006 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2006 effort. This assumes that fishing practices during 2006 were consistent with fishing practices during the 2000-2005 time period. Complete documentation of methods used to estimate cetacean bycatch mortality are described in 'Estimated Bycatch of Cetaceans in Northeast U.S. Bottom Trawl Fishing Gear' but is not available for distribution. The manuscript is expected to be published in 2008. In addition, 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 and Northeast bottom trawl fisheries.

e. The data used to predict bycatch rates to estimate annual mortality were pooled over the years 2003-2006. The data are treated as one data set and assumed to represent average fishing practices during the time period. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one given year, this does not imply that there was no

	bycatch during that year. The exception would be if year was selected by the model as an important factor associated with observing bycatch.
f.	An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001-December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row. No mortalities or serious injuries were observed for pilot whales in the NED-E, though 1 pilot whale was caught alive and released without injury (Garrison, 2003; Garrison and Richards, 2004).
g.	A cooperative research program conducted during quarters 2 and 3 in 2005 (Fairfield-Walsh and Garrison 2006).

~~Table 2. Summary of the incidental mortality and serious injury of pilot whales (*Globicephala sp.*) 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 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	Vessels [a]	Data Type [b]	Observer Coverage [c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Bottom Trawl[d]	01-05	unk	Obs. Data Dealer	.01, .01, .01, .03, .03	0, 0, 0, 0, 0	0, 0, 0, 0, 4	0, 0, 0, 0, 0	39, 38, 31, 35, 31	39, 38, 31, 35, 31	.31, .36, .31, .33, .31	38(.15)
Northeast Bottom Trawl[d]	01-05	unk	Obs. Data Dealer Data VTR Data	.01, .03, .04, .05, .12	0, 0, 0, 0, 0	0, 0, 0, 2, 4	0, 0, 0, 0, 0	21, 22, 20, 15, 15	21, 22, 20, 15, 15	.27, .26, .26, .29, .30	19(.12)
GOM/GB Herring Mid-Water Trawl JV and TALFF[e]	2001	10[f]	Obs. Data	1[g]	0	11	0	11	11	NA	11 (NA)
Mid-Altlantic Mid-Water Trawl - Including Pair Trawl[j]	01-05	23, 20, 23, 25, 31	Obs. Data Dealer Data VTR Data	0, .003, .018, .064, .084	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk, unk, 3.9, 8.1, 7.5	unk, unk, 3.9, 8.1, 7.5	unk, unk, .46, .38, .76	7 (.34)
Northeast Mid-Water Trawl - Including Pair Trawl[j]	01-05	24, 27, 28, 22, 25	Obs. Data Dealer Data VTR Data	.001, 0, .031, .126, .199	0, 0, 0, 0, 0	0, 0, 0, 1, 0	0, 0, 0, 0, 0	unk, unk, 1.9, 1.4, 1.1	unk, unk, 1.9, 1.4, 1.1	unk, unk, .56, .58, .68	1 (.35)
Pelagic Longline (excluding NED-E)[h]	01-05	98, 87, 63, 60, 60	Obs. Data Logbook	.04, .05, .09, .09, .06	4, 4, 2, 6, 9	1, 0, 0, 0, 0	50, 52, 21, 74, 212	20, 2, 0, 0, 0	70, 54, 21, 74, 212	.50, .46, .77, .42, .21	86 (.16)
Pelagic Longline - NED-E area only[h]	01-03	9, 14, 11	Obs. Data Logbook	1, 1, 1	0, 0, 0	0, 0, 0	0, 0, 0	0, 0, 0	0, 0, 0	0, 0, 0	0

~~2005 Pelagic Longline experimental fishery[i]~~	~~05~~	~~6~~	~~Obs. Data~~	~~1~~	~~1~~	~~0~~	~~1~~	~~0~~	~~1~~	~~na~~	~~1(na)~~
~~TOTAL~~											~~163(.09)~~

~~a. Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.~~
~~b. 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).~~
~~c. 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.~~
~~d. A new method was used to develop preliminary estimates of mortality for the Mid-Atlantic and Northeast trawl fisheries during 2000-2005. 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 during 2000-2005. In addition, the fisheries listed in Table 2 reflect definitions defined by the 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 fishery'.~~
~~e. NA=No joint venture or TALFF fishing effort for Atlantic herring.~~
~~f. Three foreign vessels and seven American vessels.~~
~~g. During joint venture fishing operations, nets that are transferred from the domestic vessel to the foreign vessels for processing are observed on board the foreign vessel. There may be nets fished by domestic vessels that do not get transferred to a foreign vessel for processing and therefore would not be observed. During TALFF fishing operations all nets fished by the foreign vessel are observed.~~
~~h. An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001-December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row. No mortalities or serious injuries were observed for pilot whales in the NED-E, though 1 pilot whale was caught alive and released without injury (Garrison, 2003; Garrison and Richards, 2004).~~
~~i. A cooperative research program conducted during quarters 2 and 3 in 2005 (Fairfield-Walsh and Garrison 2006).~~
~~j. The data used to predict bycatch rates to estimate annual mortality were pooled over the years 2003-2006. The data are treated as one data set and assumed to represent average fishing practices during the time period. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one given year, this does not imply that there was no bycatch during that year. The exception would be if year was selected by the model as an important factor associated with observing bycatch.~~

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 1993b, stranding databases maintained by NMFS NER, NEFSC and SEFSC). From ~~2001~~2002~~-~~ to ~~2005~~2006, ~~76~~ 72 short-finned pilot whales (*Globicephala macrorhynchus*), ~~139~~ 137 long-finned pilot whales (*Globicephala melas*), and ~~9~~ 8 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 several mass strandings as follows: 11 long-finned pilot whales mass stranded in Nantucket, ~~MA~~ Massachusetts in 2000, 57 in 2002 in Dennis, ~~MA~~Massachusetts, and 18 in Brewster, ~~MA~~ Massachusetts in 2005; 28 short-finned pilot whales stranded in Content Passage, Monroe County, ~~FL~~ Florida (Atlantic~~ocean~~ side) on 18 April ~~18,~~ 2003, and 31 short-finned pilot whales stranded on the Outer Banks of North Carolina on 15-16 January ~~15-16~~ 2005. Two juvenile animals that live stranded in Chatham, Massachusetts in 1999 were rehabilitated, satellite tagged and released (Nawojchik *et al*. 2003). Both animals were released off eastern Long Island, New York and tracked for four months in the Gulf of Maine. ~~—~~Four of 6 animals from one live stranding event in Massachusetts in 2000 were rehabilitated and released. However, certain studies have shown that frequently, animals that are returned to the water swim away and strand someplace else (Fehring and Wells 1976; Irvine *et al.* 1979; Odell *et al.* 1980). The fate of the animals, when known, is footnoted in Table 3~~, when recorded~~.

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.).

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. One short-finned pilot whale (*Globicephala macrorhynchus*) was involved in this UME.

A UME mass stranding of thirty-three short-finned pilot whales, including five pregnant females, near Cape Hatteras, NC occurred from 15-16 January 2005. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn *et al.* 2006), though no single cause for the UME was determined. Evidence is lacking to support a definitive association between this unusual mortality event and naval activity using mid-frequency active sonar in this spatial and temporal vicinity, though this does not preclude the possibility that this mass stranding was a behavioral avoidance to noise exposure associated with the naval activity. The definitive cause of this UME is not known. The authors could not "definitively conclude that there was or was not a causal link between anthropogenic sonar activity or environmental conditions (or a combination of these factors) and the strandings" (Hohn *et al.* 2006).

Short-finned pilot whales strandings (*Globicephala macrorhynchus*) 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 (*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. Most of the remaining long-finned pilot whale strandings were from North Carolina northward (Table 3).

Between 2002 and 2006, human and/or fishery interactions were documented as follows: two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes, and signs of human interaction were reported (but no specifics recorded in database) on 1 short-finned pilot whale which stranded in May 2003 in Florida. During a UME in Dare, North Carolina in January 2005, six of the 33 short-finned pilot whales which mass stranded had fishery interaction marks (specifics not given) which 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, one with a line on its flukes and another with human interactions noted but specifics not given. Of the 2006 stranding mortalities, two were reported as exhibiting signs of human interaction, one in Massachusetts and one in Virginia.

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 1997; (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 strandings occurred in Nova Scotia recently - 14 pilot whales live mass stranded in 2000 and 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.

Table 3. Pilot whale (*Globicephala macrorhynchus* (SF), *Globicephala melas* (LF) *and Globicephala* sp. (Sp) strandings along the Atlantic coast, 2002-2006. Strandings which 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	**2002**			**2003**			**2004**			**2005**			**2006**			**TOTALS**		
-	**SF**	**LF**	**Sp**	**SF**	**LF**	**Sp**	**SF**	**LF**	**Sp**	**SF**	**LF**	**Sp**	**SF**	**LF**	**Sp**	**SF**	**LF**	**Sp**
Nova Scotia[a]	0	0	7[b]	0	0	2	0	0	3	0	0	2	0	0	3	0	0	17
Maine	0	2	0	0	1	0	0	4	0	0	2	0	0	1	0	0	10	0
New Hampshire	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Massachusetts	0	65[c]	0	0	5	0	0	1	0	0	22[m]	0	0	2	0	0	95	0
Rhode Island	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	3	0

Connecticut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	4	0
New Jersey	0	0	0	0	6[d]	0	0	0	0	0	0	2	1	0	0	1	6	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	0
Virginia	0	0	0	0	3	0	0	0	1[e]	0	4[n]	0	0	2	0	0	9	1
North Carolina	0	0	0	2	0	1	1[f]	1	1[f]	35[k,l]	1	2	0	0	1	38	2	5
South Carolina	0	0	0	0	1[g]	0	0	0	0	0	0	0	0	0	0	0	1[g]	0
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	0	0	0	29[h,i]	0	0	4	0	0	0	0	0	0	0	0	33	0	0
Puerto Rico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEZ	0	0	0	0	1[j]	0	0	0	0	0	1	0	0	0	0	0	2	0
TOTALS - U.S., Puerto Rico, & EEZ	0	68	0	31	18	1	5	10	2	35	35	4	1	6	1	72	137	8

a. Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).
b. Includes 4 mass strandings at Point Tupper, Inverness County on January 11, 2002 - fate unreported.
c. Includes mass stranding of 57 long-finned pilot whales in Dennis, MA in July 2002 – majority of pod refloated and released, but rebeached 1-2 days later ; ~30 animals euthanized, and ~11 animals died during the strandings.
d. Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes.
e. One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated).
f. One short-finned pilot whale (September) and one 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 North Carolina in February, not related to any UME.
g. Only moderate confidence on species identification as long-finned pilot whale.
h. Includes mass live stranding of 28 short-finned pilot whales in Content Passage, Monroe County, FL (Ocean side) on 19 April 2003 - 12 animals died or were euthanized at the scene, 9 were returned to sea, 7 were taken into rehabilitation of which 2 subsequently died and 5 were released to sea on 10 August 2003.
i. Signs of human interaction reported on 1 stranded short-finned pilot whale (not part of the live mass stranding), which stranded in May 2003 in Florida.
j. One long-finned pilot whale floating dead on Georges Bank offshore.
k. 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.
l. Signs of fishery interaction observed on a short-finned pilot whale stranded in May in NC.
m. Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December, 2005.
n. Sign of human interaction (a line on the flukes) observed on 2 animals, and one animal was a pregnant female.

~~Table 3. Pilot whale (*Globicephala macrorhynchus* (SF), *Globicephala melas* (LF) and *Globicephala* sp. (Sp) strandings along the Atlantic coast, 2001-2005. Strandings which 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~~	~~2001~~			~~2002~~			~~2003~~			~~2004~~			~~2005~~			~~TOTALS~~		
~~-~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~

Nova Scotia[a]	0	0	3[b]	0	0	7[c]	0	0	2	0	0	3	0	0	2	0	0	17
Maine	1	5[d]	0	0	2	0	0	1	0	0	4	0	0	2	0	1	14	0
New Hampshire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Massachusetts	0	3	0	0	65[e]	0	0	5	0	0	1	0	0	22[o]	0	0	96	0
Rhode Island	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	3	0
Connecticut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York	0	1	0	0	0	0	0	0	0	0	3	0	0	1	0	0	5	0
New Jersey	0	0	0	0	0	0	0	6[f]	0	0	0	0	0	0	2	0	6	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	0
Virginia	0	0	0	0	0	0	0	3	0	0	0	1[g]	0	4	0	0	7	1
North Carolina	1	0	1	0	0	0	2	0	1	1[h]	1	1[h]	35[m,n]	1	2	39	2	5
South Carolina	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1[i]	0
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	0	0	0	0	0	0	29[j,k]	0	0	4	0	0	0	0	0	33	0	0
Puerto Rico	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
EEZ	0	0	0	0	0	0	0	1[l]	0	0	0	0	0	0	1	0	1	1
TOTALS - U.S., Puerto Rico, & EEZ	5	9	1	0	68	0	31	18	1	5	10	2	35	34	5	76	139	9

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

b. Three mass live stranded animals at Judique, Inverness County on July 19, 2001 – all returned to sea.

c. Includes 4 mass strandings at Point Tupper, Inverness County on January 11, 2002 - fate unreported.

d. Includes one long finned pilot whale stranded with possible propeller marks in Maine in September 2001.

e. Includes mass stranding of 57 long-finned pilot whales in Dennis, MA in July 2002 – majority of pod refloated and released, but rebeached 1-2 days later ; ~30 animals euthanized, and ~11 animals died during the strandings.

f. Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes.

g. One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated).

h. One short-finned pilot whale (September '04) and one pilot whale (November '04) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in North Carolina in February, not related to any UME.

i. Only moderate confidence on species identification as long-finned pilot whale.

j. Includes mass live stranding of 28 short-finned pilot whales in Content Passage, Monroe County, FL (Ocean side) on April 19, 2003 - 12 animals died or were euthanized at the scene, 9 were returned to sea, 7 were taken into rehabilitation of which 2 subsequently died and 5 were released to sea on August 10, 2003.

k. Signs of human interaction reported on 1 stranded short-finned pilot whale (not part of the live mass stranding), which stranded in May 2003 in Florida.

l. One long-finned pilot whale floating dead on Georges Bank offshore.

m. 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.

n. Signs of fishery interaction observed on a short-finned pilot whale stranded in May in NC.

o. Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December, 2005.

p. Sign of human interaction (a line on the flukes) observed in both animals, and one animal was a pregnant female.

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 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 not a strategic stock because the ~~2001~~2002~~-2005~~ 2006 estimated average annual human-related mortality does not exceed PBR. However, the continuing inability to distinguish between species of pilot whales raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The short-finned pilot whale is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983). There are two species of pilot whales in the western North Atlantic - the Atlantic or long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea; therefore, much of the descriptive material below refers to *Globicephala* sp. and is identified as such. Sightings of these animals in the U.S. Atlantic EEZ occur in oceanic waters (Mullin and Fulling 2003) and 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). Information on stock differentiation for the Atlantic population based on morphological, genetic and/or behavioral data is in progress. Pending these results, the western North Atlantic *Globicephala* sp. ~~population(s)are~~population(s) is provisionally being considered a separate stock from the northern Gulf of Mexico stock(s).

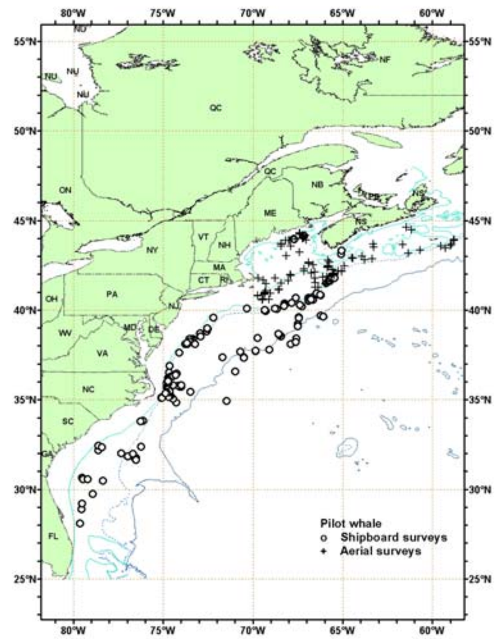

Figure 1. Distribution of pilot whale sightings from NEFSC and SEFSC vessel and aerial summer surveys during 2004 and 2006. Isobaths are at 100 m, 1,000 m, and 4,000 m.

POPULATION SIZE

The total number of short-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. Sightings were almost exclusively in the continental shelf edge and continental slope areas (Figure 1). Because long-finned and short-finned pilot whales are difficult to identify at sea, seasonal abundance estimates are reported for *Globicephala* sp., both long-finned and short-finned pilot whales. The best abundance estimate for *Globicephala* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys. This joint estimate (15,728 + 15,411 = 31,139 whales) is considered best because these two surveys together have the most complete coverage of the species' habitat.

Earlier Estimates

Mitchell (1974) used cumulative catch data from the 1951-1961 drive ~~fishery~~fisheries off Newfoundland to estimate the initial population size (ca. 50,000 animals).

Mercer (1975) used population models to estimate a population in the same region of between 43,000 and 96,000 long-finned pilot whales, with a range of 50,000-60,000.

An abundance estimate of 11,120 (CV=0.29) *Globicephala* sp. was obtained from an aerial survey program conducted from 1978 to 1982 in continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982).

An abundance estimate of 3,636 (CV=0.36) *Globicephala* sp. was obtained from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundances estimates of 3,368 (CV=0.28) and 5,377 (CV=0.53) *Globicephala* sp. were derived from line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11 aircrafts (NMFS 1991).

An abundance estimate of 668 (CV=0.55) *Globicephala* sp. was obtained from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993a).

A 1995 abundance estimate of 9,776 (CV=0.55) *Globicephala* sp. was generated from the sum of the estimates of 8,176 (CV=0.65) *Globicephala* sp. from the U.S. July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence, and 1,600 (CV=0.65)

Globicephala sp. from Canadian aerial surveys in late August and early September in the Gulf of St. Lawrence in 1995 and 1998 (Kingsley and Reeves 1998).

An abundance estimate of 14,909 (CV = 0.26) *Globicephala* sp. was obtained from the sum of the estimate of 9,800 *Globicephala* sp. (CV=0.34) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 5,109 (CV = 0.41) *Globicephala* sp., estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable and should not be used for PBR determinations. 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

An abundance estimate of 5,408 (CV=0.56) *Globicephala* sp. 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)*, the probability of detecting a group on the track line, used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

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 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~~transects 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 >50m) between Florida and Maryland (27.5ºN and 38ºN latitude) was conducted during June-August 2004. The survey employed two independent visual teams searching with ~~50x~~ 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). The resulting abundance estimate for *Globicephala* sp. between Florida and Maryland was 15,411 animals (CV =0.43).

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 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.)

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	15,411	0.43
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	31,139	0.27
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	26,535	0.35

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 *Globicephala* sp. is 31,139 animals (CV=0.27) derived from the 2004 surveys. The minimum population estimate for *Globicephala* sp. is 24,866.

Current Population Trend

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

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 long-finned pilot whales ~~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 ~~is~~of 177 cm; mean length at sexual maturity ~~is~~of 490 cm for males and 356 cm for females; age at sexual maturity of~~is~~ 12 years for males and 6 years for females; mean adult length ~~is~~of 557 cm for males and 448 cm for females; and maximum age of~~was~~ 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 for long-finned pilot whales 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 *Globicephala* sp. is 24,866. 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 *Globicephala* sp. is 249. It is not possible to determine the PBR for only short-finned pilot whales.

ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2002-2006 was 165 pilot whales (CV=0.14); Table 2).

Fishery Information

Detailed fishery information is reported in Appendix III. Total fishery-related mortality and serious injury cannot be estimated separately for the two 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 northeast 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 ~~Magnuson-Stevens~~ Fisheries Conservation and Management Act (~~MS~~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~~as~~ 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. Due to temporal fishing restrictions, the bycatch occurred during winter/spring (December to May) in continental shelf and continental shelf edge waters (Fairfield *et al.* 1993; Waring 1995); withhowever, the majority of the takes occurringed in late spring along the 100 m isobath. 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).

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 one interaction, the net was actually pursed around one 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 n. No marine mammals were observed taken during these trips.

No pilot whales were taken in observed mid-Atlantic Coastal Gillnet trips during 1993-1997. One pilot whale was observed taken in 1998, and none were observed taken from 0 during 111999-2003. 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 (CV in parentheses) attributed to this fishery was 7 in 1998 (CV=1.10).

One pilot whale take was observed in the *Ilex* squid portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish 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 New England/Mid-Atlantic Squid, Mackerel, Butterfishand Butterfish 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=.97). THowever, these estimates should, however, be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery wasishas been included as a component of the mid-Atlantic bottom trawl fishery.

There was one observed take in the Southern New England/mid-Atlantic Bottom Trawl fishery reported in 1999. The estimated fishery-related mortality for pilot whales attributable to this fishery was 0 fromin 1996-1998, and 228 (CV= 1.03) in 1999. After 1999 this fishery waishas 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 iwas from U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999; Yeung 2001; Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006, 2007). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and 20065, 109 128 pilot whales were released alive, including 61 73 that were considered seriously injured, and 4 5 mortalities were observed (Johnson *et al.* 1999; Yeung 2001; Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006, 2007; Fairfield-Walsh and Garrison 2007). 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 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 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, and 16 (CV = 1.00) in 2006. 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), ~~and~~ 212 in 2005 (CV=0.21), and 16~~6~~9 in 2006 (CV = 0.31). The average 'combined' annual mortality in 200~~1~~2-2006~~5~~ was ~~86~~ 10~~8~~9 pilot whales (CV=0.~~16~~20) (Table 2).

An experimental fishery was conducted on six vessels operating in the Gulf of Mexico and off the U.S. east coast in 2005, with 100% observer coverage achieved during this experimental fishery. During this experiment, different hook baiting techniques 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 one which 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~~ and~~, four in 2005, and one in 2006. 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, ~~and~~ 31 (CV=0.31) in 2005, and 37 (CV=0.34) in 2006. The ~~2001~~2002-~~2005~~ 2006 average mortality attributed to the Mid-Atlantic bottom trawl was ~~38~~ 34 animals (CV=0.15).

Northeast Bottom Trawl

Two pilot whales were observed taken in the Northeast bottom trawl in 2004~~ and~~, four in 2005, and one in 2006. 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, ~~and~~ 15 (0.30) in 2005, and 14 (0.28) in 2006. The ~~2001~~2002-~~2005~~ 2006 average mortality attributed to the northeast bottom trawl was ~~19~~ 1~~1~~5 animals (CV=0.~~12~~13).

~~**GOM/GB Herring Mid-Water Trawl JV and TALFF**~~

~~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) (Table 2). The 2001-2005 average mortality attributed to the Atlantic herring mid-water trawl fishery was 11 animals (Table 2).~~

Northeast Mid-Water Trawl – Including Pair Trawl

The observer coverage in this fishery was highest after 2003, though a few trips in earlier years were observed (Table 2). A pilot whale was observed taken in the single trawl fishery on the northern edge of Georges Bank (off of Massachusetts) in a haul that was targeting (and primarily caught) herring in 2004. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 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, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities ~~(CV in parentheses)~~ were: unknown in 2001-2002, 1.9 (CV=0.56) in 2003, ~~and~~ 1.4 (CV=0.58) in 2004, ~~and~~ 1.1(CV=.68) in 2005, and 0 in 2006. (Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during ~~2001~~2002-~~2005~~ 2006 was 1 (CV=0.35).

Mid-Atlantic Mid-W~~w~~ater Trawl Fishery (Including Pair Trawl)

The observer coverage in this fishery was highest after 2003, though a few trips in other years were observed (Table 2). No pilot whales were observed bycaught in this fishery between ~~2001~~2002-~~2005~~2006, though because of data pooling, estimates were still generated. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 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, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities ~~(CV in parentheses)~~ were unknown in 2001-2002, 3.9 (CV=0.46) in 2003, 8.1 (CV=0.38) in 2004, ~~and~~ 7.5 (CV=.76) in 2005, and 0 in 2006 (Table 2; Palka pers. com.). The average annual estimated fishery-related mortality during ~~2001~~2002-~~2005~~ 2006 was 5 (CV=0.34).

CANADA

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

Table 2. Summary of the incidental mortality and serious injury of pilot whales (*Globicephala sp.*) 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 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	Vessels[a]	Data Type[b]	Observer Coverage[c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality[d]	Estimated Combined Mortality	Estimated CVs	Mean ~~A~~Annual Mortality
Mid-Atlantic Bottom Trawl[d]	~~01~~02-~~05~~06	unk	Obs. Data Dealer	~~.01,~~ .01, .01, .03, .03, .02	0, 0, 0, 0, 0	~~0,~~ 0, 0, 0, 4, 1	0, 0, 0, 0, 0	~~39,~~ 38, 31, 35, 31, 37	~~39,~~ 38, 31, 35, 31, 37	~~.31,~~ .36, .31, .33, .31, .34	~~38~~34 (.15)
Northeast Bottom Trawl[d]	~~01~~02-~~05~~[d]06	unk	Obs. Data Dealer Data VTR Data	~~.01,~~ .03, .04, .05, .12, .06	0, 0, 0, 0, 0	~~0,~~ 0, 0, 0, 2, 4, 1	0, 0, 0, 0, 0	~~21,~~ 22, 20, 15, 15, 14	~~21,~~ 22, 20, 15, 15, 14	~~.27,~~ .26, .26, .29, .30, .28	~~19~~15 (.~~12~~13)
~~GOM/GB Herring Mid-Water Trawl-JV and TALFF~~[e]	~~2001~~	~~10~~[f]	~~Obs. Data~~	~~1~~[g]	~~0~~	~~11~~	~~0~~	~~11~~	~~11~~	~~NA~~	~~11 (NA)~~
Mid-~~Altlantic~~Atlantic Mid-Water Trawl - Including	~~01~~02-~~05~~06	~~23,~~ 20, 23, 25, 31, ??	Obs. Data Dealer Data VTR Data	~~0,~~ .003, .018, .064, .084, .089	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	~~unk,~~ unk, 3.9, 8.1, 7.5, 0	~~unk,~~ unk, 3.9, 8.1, 7.5, 0	~~unk,~~ unk, .46, .38, .76, 0	5~~7~~ (.34)

Pair ~~Trawl~~[i] Trawl[e]											
Northeast Mid-Water Trawl - Including Pair Trawl[e]	~~01~~02-~~05~~06	~~24,~~ 27, 28, 22, 25, ??	Obs. Data Dealer Data VTR Data	~~.001,~~ 0, .031, .126, .199, .031	0, 0, 0, 0, 0	~~0,~~ 0, 0, 1, 0, 0	0, 0, 0, 0, 0	~~unk,~~ unk, 1.9, 1.4, 1.1, 0	~~unk,~~ unk, 1.9, 1.4, 1.1, 0	~~unk,~~ unk, .56, .58, .68, 0	1 (.35)
Pelagic Longline (excluding NED-E)[~~h~~ f]	~~01~~02-~~05~~06	~~98,~~ 87, 63, 60, 60, 63	Obs. Data Logbook	~~.04,~~ .05, .09, .09, .06, .07	~~4,~~ 4, 2, 6, 9, 12	~~1,~~ 0, 0, 0, 0, 1	~~50,~~ 52, 21, 74, 212, 16~~6~~9	~~20,~~ 2, 0, 0, 0, 16	~~70,~~ 54, 21, 74, 212, 185	~~.50,~~ .46, .77, .42, .21, .47	~~86~~109 (.~~16~~20)
Pelagic Longline - NED-E area only[~~h~~f]	0~~1~~2-03	~~9,~~ 14, 11	Obs. Data Logbook	~~1,~~ 1, 1	~~0,~~ 0, 0	~~0,~~ 0, 0	~~0,~~ 0, 0	~~0,~~ 0, 0	~~0,~~ 0, 0	~~0,~~ 0, 0	0
2005 Pelagic Longline experimental ~~fishery~~[i] fishery[g]	05	6	Obs. Data	1	1	0	1	0	1	1.00~~na~~	1 ~~(na~~(1.00)~~)~~
TOTAL											~~163~~164~~5~~5 (.~~09~~14)

a. Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.

b. 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).

c. 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.

~~d.~~ d. A new method was used to develop estimates of mortality for the Mid-Atlantic and Northeast bottom trawl fisheries during 2000-2006. 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 during 2000-2006. NE and MA bottom trawl mortality estimates reported for 2006 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2006 effort. This assumes that fishing practices during 2006 were consistent with fishing practices during the 2000-2005 time period. Complete documentation of methods used to estimate cetacean bycatch mortality are described in 'Estimated Bycatch of Cetaceans in Northeast U.S. Bottom Trawl Fishing Gear' but is not available for distribution. The manuscript is expected to be published in 2008. In addition, 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 and Northeast bottom trawl fisheries. ~~A new method was used to develop preliminary estimates of mortality for the Mid-Atlantic and Northeast trawl fisheries during 2000-2005. 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 during 2000-2005. In addition, the fisheries listed in Table 2 reflect definitions defined by the 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 fishery'.~~

~~e. NA=No joint venture or TALFF fishing effort for Atlantic herring.~~

~~f. Three foreign vessels and seven American vessels.~~

~~g. During joint venture fishing operations, nets that are transferred from the domestic vessel to the foreign vessels for processing are observed on board the foreign vessel. There may be nets fished by domestic vessels that do not get transferred to a foreign vessel for processing and therefore would not be observed. During TALFF fishing operations all nets fished by the foreign vessel are observed.~~ e. The data used to predict bycatch rates to estimate annual mortality were pooled over the years 2003-2006. The data are treated as one data set and assumed to represent average fishing practices during the time period. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one given year, this does not imply that there was no bycatch during that year. The exception would be if year was selected by the model as an important factor associated with observing bycatch.

~~h~~f. An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001-December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row. No mortalities or serious injuries were observed for pilot whales in the NED-E, though 1 pilot whale was caught alive and released without injury (Garrison, 2003; Garrison and Richards, 2004).

~~i~~g. A cooperative research program conducted during quarters 2 and 3 in 2005 (Fairfield-Walsh and Garrison 2006).

j. The data used to predict bycatch rates to estimate annual mortality were pooled over the years 2001-2005. The data are treated as one data set and assumed to represent average fishing practices during the time period. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one given year, this does not imply that there was no bycatch during that year. The exception would be if year was selected by the model as an important factor associated with observing bycatch.

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 1993b, stranding databases maintained by NMFS NER, NEFSC and SEFSC). From 20012002-20052006, 76 72 short-finned pilot whales (*Globicephala macrorhynchus*), 139 137 long-finned pilot whales (*Globicephala melas*), and 9 8 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 several mass strandings as follows: 11 long-finned pilot whales mass stranded in Nantucket, MA Massachusetts in 2000 and 57 in 2002 in Dennis, MassachusettsMA; 28 short-finned pilot whales stranded in Content Passage, Monroe County, FL Florida (ocean Atlantic side) on 18 April 18, 2003; and 18 pilot whales (including one pregnant female) were part of a multi-species mass stranding in Barnstable County, MassachusettsMA on 10 December, 2005. Two juvenile animals that live stranded in Chatham, Massachusetts in 1999 were rehabilitated, satellite tagged and released (Nawojchik *et al.* 2003). Both animals were released off eastern Long Island, New York and tracked for four months in the Gulf of Maine. Four of 6 animals from one live stranding event in Massachusetts in 2000 were rehabilitated and released. However, certain studies have shown that frequently animals that are returned to the water swim away and strand someplace else (Fehring and Wells 1976; Irvine *et al.* 1979; Odell *et al.* 1980). The fate of the animals, when known, is footnoted in Table 3, when recorded.

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.).

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. One short-finned pilot whale (*Globicephala macrorhynchus*) was involved in this UME.

A mass stranding of thirty-three short-finned pilot whales, including five pregnant females, occurred near Cape Hatteras, NC North Carolina from 15-16 January 2005. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn *et al.* 2006), though no single cause for the UME was determined. The pilot whales were not emancipated though there was no recently ingested prey in their stomachs. Three pilot whales had clinical evidence of pre-existing systemic inflammation based on the histopathology findings. Healed fishery interactions and verminous pterygoid sinusitis was seen in some pilot whales, but was not thought to be the cause of debilitation or death. There was evidence of clinically significant disease and musculoskeletal disease and intra-abdominal granulomas in two pilot whales, and cardiovascular disease in one pilot whale, all of which could have been causal factors in the stranding, though this determination was not definitive. One pilot whale had a subdural hemorrhage, which could be a debilitating condition. Three of five tested pilot whales had positive morbillivirus titers, though there was no histopathology evidence of active viral infection. Twenty-six pilot whales had parasites (nematodes, cestodes, and trematodes), though the parasite species, locations and loads were within normal limits for free-ranging cetaceans and were not considered the causative factor in this stranding. Gas emboli lesions associated with previously studied sonar-associated strandings of other small cetaceans were not found in any stranded animals. Evidence is lacking to support a definitive association between this unusual mortality event and naval activity using mid-frequency active sonar in this spatial and temporal vicinity, though this does not preclude the possibility that this mass stranding was a behavioral avoidance to noise exposure associated with the naval activity. The definitive cause of this UME is not known. The authors could not "definitively conclude that there was or was not a causal link between anthropogenic sonar activity or environmental conditions (or a combination of these factors) and the strandings".

Table 3. Pilot whale (*Globicephala macrorhynchus* (SF), *Globicephala melas* (LF) and *Globicephala* sp. (Sp) strandings along the Atlantic coast, 2001-2005. Strandings which 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	2001			2002			2003			2004			2005			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp
Nova Scotia[a]	0	0	3[b]	0	0	7[c]	0	0	2	0	0	3	0	0	2	0	0	17
Maine	1	5[d]	0	0	2	0	0	1	0	0	4	0	0	2	0	1	14	0
New Hampshire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Massachusetts	0	3	0	0	65[e]	0	0	5	0	0	1	0	0	22[o]	0	0	96	0
Rhode Island	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	3	0
Connecticut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York	0	1	0	0	0	0	0	0	0	0	3	0	0	1	0	0	5	0
New Jersey	0	0	0	0	0	0	0	6[f]	0	0	0	0	0	0	2	0	6	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	0
Virginia	0	0	0	0	0	0	0	3	0	0	0	1[g]	0	4[p]	0	0	7	1
North Carolina	1	0	1	0	0	0	2	0	1	1[h]	1	1[h]	35[m,n]	1	2	39	2	5
South Carolina	1	0	0	0	0	0	0	1[i]	0	0	0	0	0	0	0	1	1[i]	0
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	0	0	0	0	0	0	29[j,k]	0	0	4	0	0	0	0	0	33	0	0
Puerto Rico	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
EEZ	0	0	0	0	0	0	0	1[l]	0	0	0	0	0	0	1	0	1	1
TOTALS - U.S., Puerto Rico, & EEZ	5	9	1	0	68	0	31	18	1	5	10	2	35	34	5	76	139	9

a. Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).
b. Three mass live stranded animals at Judique, Inverness County on July 19, 2001 - all returned to sea.
c. Includes 4 mass strandings at Point Tupper, Inverness County on January 11, 2002 - fate unreported.
d. Includes one long finned pilot whale stranded with possible propeller marks in Maine in September 2001.
e. Includes mass stranding of 57 long-finned pilot whales in Dennis, MA in July 2002 – majority of pod refloated and released, but rebeached 1-2 days later; ~30 animals euthanized, and ~11 animals died during the strandings.
f. Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes.
g. One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated).
h. One short-finned pilot whale (September 2004) and one pilot whale (November 2004) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in North Carolina in February, not related to any UME.
i. Only moderate confidence on species identification as long-finned pilot whale.
j. Includes mass live stranding of 28 short-finned pilot whales in Content Passage, Monroe County, FL (Ocean side) on April 19, 2003 - 12 animals died or were euthanized at the scene, 9 were returned to sea, 7 were taken into rehabilitation of which 2 subsequently died and 5 were released to sea on August 10, 2003.
k. Signs of human interaction reported on 1 stranded short-finned pilot whale (not part of the live mass stranding), which stranded in May 2003 in Florida.
l. One long-finned pilot whale floating dead on Georges Bank offshore.
m. Includes Unusual Mortality Event mass stranding of 33 short-finned pilot whales in Dare, NC on 15-16 January, 2005, including five pregnant females. Six animals had fishery interaction marks, which were healed and not the cause of death.
n. Signs of fishery interaction observed on a short-finned pilot whale stranded in May in NC.
o. Includes 18 pilot whales which were part of a multi-species mass stranding in Barnstable County, MA on 10 December, 2005. This includes one pregnant female.

~~p. Sign of human interaction (a line on the flukes) observed in both animals, and one animal was a pregnant female.~~

Table 3. Pilot whale (*Globicephala macrorhynchus* (SF), *Globicephala melas* (LF) *and Globicephala* sp. (Sp) strandings along the Atlantic coast, 2002-2006. Strandings which 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	**2002**			**2003**			**2004**			**2005**			**2006**			**TOTALS**		
	SF	**LF**	**Sp**	**SF**	**LF**	**Sp**	**SF**	**LF**	**Sp**	**SF**	**LF**	**Sp**	**SF**	**LF**	**Sp**	**SF**	**LF**	**Sp**
Nova Scotia[a]	0	0	7[b]	0	0	2	0	0	3	0	0	2	0	0	3	0	0	17
Maine	0	2	0	0	1	0	0	4	0	0	2	0	0	1	0	0	10	0
New Hampshire	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Massachusetts	0	65[c]	0	0	5	0	0	1	0	0	22[m]	0	0	2	0	0	95	0
Rhode Island	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	3	0
Connecticut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	4	0
New Jersey	0	0	0	0	6[d]	0	0	0	0	0	0	2	1	0	0	1	6	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	0
Virginia	0	0	0	0	3	0	0	0	1[e]	0	4[n]	0	0	2	0	0	9	1
North Carolina	0	0	0	2	0	1	1[f]	1	1[f]	35[k,l]	1	2	0	0	1	38	2	5
South Carolina	0	0	0	0	1[g]	0	0	0	0	0	0	0	0	0	0	0	1[g]	0
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	0	0	0	29[h,i]	0	0	4	0	0	0	0	0	0	0	0	33	0	0
Puerto Rico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEZ	0	0	0	0	1[j]	0	0	0	0	0	1	0	0	0	0	0	2	0
TOTALS - U.S., Puerto Rico, & EEZ	0	68	0	31	18	1	5	10	2	35	35	4	1	6	1	72	137	8

a. Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).
b. Includes 4 mass strandings at Point Tupper, Inverness County on January 11, 2002 - fate unreported.
c. Includes mass stranding of 57 long-finned pilot whales in Dennis, MA in July 2002 – majority of pod refloated and released, but rebeached 1-2 days later ; ~30 animals euthanized, and ~11 animals died during the strandings.
d. Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes.
e. One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated).
f. One short-finned pilot whale (September~~ '04~~) and one pilot whale (November~~ '04~~) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in North Carolina in February, not related to any UME.
g. Only moderate confidence on species identification as long-finned pilot whale.
h. Includes mass live stranding of 28 short-finned pilot whales in Content Passage, Monroe County, FL (Ocean side) on 19 April ~~19,~~ 2003 - 12 animals died or were euthanized at the scene, 9 were returned to sea, 7 were taken into rehabilitation of which 2 subsequently died and 5 were released to sea on 10 August ~~10,~~ 2003.
i. Signs of human interaction reported on 1 stranded short-finned pilot whale (not part of the live mass stranding), which stranded in May 2003 in Florida.
j. One long-finned pilot whale floating dead on Georges Bank offshore.
k. 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.
l~~1~~. Signs of fishery interaction observed on a short-finned pilot whale stranded in May in NC.

m. Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December~~,~~ 2005.
n. Sign of human interaction (a line on the flukes) observed o~~i~~n 2 animals, and one animal was a pregnant female.

Short-finned pilot whales strandings (*Globicephala macrorhynchus*) 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 (*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. Most of the remaining long-finned pilot whale strandings were from North Carolina northward (Table 3).

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 1997;~~ 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 strandings occurred in Nova Scotia recently - 14 pilot whales live mass stranded in 2000 and 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.

Between ~~2001~~2002-~~2005~~2006, human and/or fishery interactions were documented as follows: ~~one long-finned pilot whale stranded with possible propeller marks in Maine in September 2001,~~ two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes, and signs of human interaction were reported (but no specifics recorded in database) on 1 short-finned pilot whale which stranded in May 2003 in Florida. During a UME in Dare, North Carolina in January 2005, six of the 33 short-finned pilot whales which mass stranded had fishery interaction marks (specifics not given) which 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, one with a line on its flukes and another with human interactions noted but specifics not given. Of the 2006 stranding mortalities, two were reported as exhibiting signs of human interaction, one in Massachusetts~~A~~ and one in Virginia~~A~~.

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 fishery-related mortality and serious injury for *Globicephala* sp. 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 not a strategic stock because the 2002~~1~~-2006~~5~~ estimated average annual human related mortality does not exceed PBR. However, the continuing inability to distinguish between species of pilot whales raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.

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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 100m depth contour. The species inhabits waters from central West Greenland to North Carolina (about 35˚N) and perhaps as far east as 43˚W (Evans 1987; Hamazaki 2002). Distribution of sightings, strandings and incidental takes suggest the possible existence of three stock~~s~~ 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. 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.

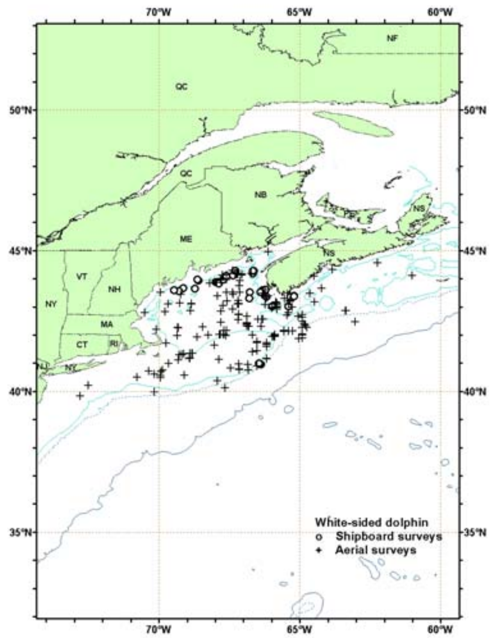

Figure 1. *Distribution of white-sided dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

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.

Prior to the 1970s, white-sided dolphins in U.S. waters were found primarily offshore on the continental slope, while white-beaked dolphins (*L. albirostris*) were found on the continental shelf. During the 1970s, there was an apparent switch in habitat use between these two species. This shift may have been a result of the decrease in herring and increase in sand lance in the continental shelf waters (Katona *et al.* 1993; Kenney *et al.* 1996).

POPULATION SIZE

The total number of white-sided dolphins along the eastern U.S. and Canadian Atlantic coast is unknown, although eight estimates from select regions are available from: 1) spring, summer and autumn 1978-1982; 2) July-September 1991-1992; 3) June-July 1993; 4) July-September 1995; 5) July-August 1999; 6) August 2002; 7) June-July 2004; and 8) August 2006. The best available current abundance estimate for white-sided dolphins in the western North Atlantic stock is 63,368 (CV=0.27), 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.

Earlier abundance estimates

An abundance estimate of 28,600 white-sided dolphins (CV=0.21) was obtained from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982Blaylock 1995). An abundance estimate of 20,400 (CV=0.63) white-sided dolphins was obtained from two shipboard line transect surveys conducted during July to September 1991 and 1992 in the northern Gulf of Maine-lower Bay of Fundy region (Palka *et al.* 1997). An abundance estimate of 729 (CV=0.47) white-sided dolphins was obtained from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993). An abundance estimate of 27,200 (CV=0.43) white-sided dolphins was obtained from a July to September 1995 sighting survey conducted by two ships and an airplane that covered 32,600 km in waters from Virginia to the mouth of the Gulf of St. Lawrence. Kingsley and Reeves (1998) estimated that there were 11,740 (CV=0.47) white-sided dolphins in the Gulf of St. Lawrence during 1995 and 560 (CV=0.89) white-sided dolphins in the northern Gulf of St. Lawrence during 1996. It is assumed these estimates apply to the Gulf of St. Lawrence stock. During the 1995 survey, 8,427 km of track lines were flown in an area of 221,949 km^2 during August and September. During the 1996 survey, 3,993 km of track lines were flown in an area of 94,665 km^2 during July and August.

An abundance estimate of 51,640 (CV=0.38) white-sided dolphins was obtained from a 28 July to 31 August 1999 line-transect sighting survey conducted from a ship and an airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Total track line length was 8,212 km. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) which accounts for school size bias and for *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Palka 2000). The 1999 estimate is larger than the 1995 estimate due to, at least in part, the fact that the 1999 survey covered the upper Bay of Fundy and the northern edge of Georges Bank for the first time and white-sided dolphins were seen in both areas. 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.

Formatte

Recent surveys and abundance estimates

An abundance estimate of 51,640 (CV=0.38) white-sided dolphins was obtained from a 28 July to 31 August 1999 line-transect sighting survey conducted from a ship and an airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Total track line length was 8,212 km. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) which accounts for school size bias and for *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Palka 2000). The 1999 estimate is larger than the 1995 estimate due to, at least in part, the fact that the 1999 survey covered the upper Bay of Fundy and the northern edge of Georges Bank for the first time and white-sided dolphins were seen in both areas.

An abundance estimate 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 data of 2002, 2004 and 2006 aerial survey data.

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 100m 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 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).

An abundance estimate of 17,594 (CV=0.30) white-sided dophins was generated from an aerial survey conducted in August 2006 which surveyed 10,676 km of trackline in the region from the 2000m 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 average abundance estimate of white-sided dolphins from surveys conducted in August during the last 8 years (2002 and 20042006) is 63,368 (CV=0.27). An average was used to incorporate the large inter-annual variability and thus provide an average number of white-sided dolphins that could be within the Gulf of Maine-western Scotian shelf region.

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
~~Jul-Aug 1999~~	~~Georges Bank to mouth of Gulf of St. Lawrence~~	~~51,640~~	~~0.38~~
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

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 63,368 (CV=0.27). The minimum population estimate for these white-sided dolphins is 50,883.

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. 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 110cm; 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 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 ~~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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2002-2006 was 352 (CV=0.09) 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 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 ~~2005~~2006, 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 from 1994 to ~~2005~~2006. There was no fishery during 1997.

A U.S. joint venture (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 2 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-~~2005~~2006.

U.S.

Northeast Sink Gillnet

This fishery occurs year round from in the Gulf of Maine, Georges Bank and in southern New England waters. Between 1990 and ~~2005~~ 2006 there were ~~54~~ 56 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 mortalities (CV in parentheses) 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, ~~and~~ 59 (0.49)in 2005, and 41(.71) in 2006. Average annual estimated fishery-related mortality during ~~2001~~2002-~~2005~~ 2006 was ~~31~~ 34 white-sided dolphins per year (0.~~35~~33) (Table 2).

Northeast Bottom Trawl

Forty-~~three~~ seven mortalities were documented between 1991 and ~~2005~~ 2006 in the Northeast bottom trawl fishery; 1 during 1992, 0 in 1993, 2 in 1994, 0 in 1995-2001, 1 in 2002, 12 in 2003, 16 in 2004, and 12 in 2005. 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, ~~and~~ 213 (0.28) in 2005, and 164(0.34) in 2006. The ~~2001~~2002-~~2005~~ 2006 average mortality attributed to the northeast bottom trawl was ~~192~~ 193 animals (CV=0.13)(Table 2).

~~**Northeast Atlantic (Gulf of Maine/Georges Bank) JV and TALFF Herring Fishery**~~

~~A U.S. joint venture (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) (Table 2). 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 2 animals (Table 2).~~

Northeast Mid-water Trawl Fishery (Including Pair Trawl)

The observer coverage in this fishery was highest after 2003, though a few trips in earlier years were observed (Table 2). A white-sided dolphin was observed taken in the single trawl fishery on the northern edge of Georges Bank (off of Massachusetts) during July 2003 in a haul that was targeting (and primarily caught) herring, ~~and~~ and ~~-~~3 white-sided dolphins were taken in 2005 in paired trawls targeting herring. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 observed mid-water trawl data from paired and single 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, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities (CV in parentheses) were unknown in 2001-2002, 24 (0.56) in 2003, 19 (0.58) in 2004, ~~and~~ 15(.68) in 2005, and 19 (.44) in 2006 (Table 2; Palka pers. com.). The average annual estimated fishery-related mortality during 200~~1~~2-200~~5~~6 was 19 (0.~~35~~26).

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

The observer coverage in this fishery was highest after 2003, though a few trips in other years were observed (Table 2). A white-sided dolphin was observed taken in the pair trawl fishery near Hudson Canyon (off New Jersey) during February 2004 in a haul that was targeting mackerel (and landed nothing). ~~In 2005, 5~~Five white-sided dolphins were taken in paired trawls targeting mackerel in 2005 and three were taken in 2006.~~ ~~ Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 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, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities (CV in parentheses) were unknown in 2001-2002, 51 (0.46) in 2003, 105 (0.38) in 2004, ~~and~~ 97(.76) in 2005, and 54 (.57) in 2006 (Table 2; Palka pers. com.). The average annual estimated fishery-related mortality during 2002~~1~~-2006~~5~~ was 77~~84~~ (0.21~~34~~).

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, and one take was observed in 2005. ~~Recently observer coverage for this fishery was around 1%, except for 2004 where it was 3% (Table 2).~~ 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, ~~and~~ 38 (0.29) in 2005, and 26 (0.25) in 2006. The ~~2001~~2002-~~2005~~ 2006 average mortality attributed to the mid-Atlantic bottom trawl was 29 animals (CV=0.11).

Table 2. Summary of the incidental mortality of white-sided dolphins (*Lagenorhynchus acutus*) 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	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet[d]	~~01~~02-~~05~~06	1993=349 1998=301	Obs. Data Weighout Trip Logbook	~~.04,~~ .02, .03, .06, .07, .04	~~1[e],~~ 1[e], 1[e], 1[e], 5, 2	~~26[e],~~ 30[e], 31[e], 7[e], 59 [e], 41	~~1.00,~~ .74, .93, .98, .49 [e], .71	~~31~~ 34 (0.~~35~~33)
Northeast Bottom Trawl[c]	~~01~~02-~~05~~06	unk	Obs. Data Weighout	~~.01,~~ .03, .04, .05, .12, .06	~~0,~~ 1, 12, 16, 47, 4	~~161,~~ 170, 216, 200, 213, 164	~~.34,~~ .32, .27, .30, .28, .34	~~192~~ 193 (0.13)
~~GOM/GB Herring Trawl-TALFF~~	~~2001~~	~~2[f]~~	~~Obs. Data~~	~~1.00[f]~~	~~2~~	~~2~~	~~0~~	~~2 (0)~~
Northeast Mid-water Trawl - Including Pair Trawl	02~~1~~-06~~5~~	~~24,~~ 27, 28, 22, 25, 25	Obs. Data Weighout Trip Logbook	~~.001,~~ 0, .031, .126, .199, .031	~~0,~~0,1,0,3, 0	~~unk,~~ unk, 24, 19, 15, 19	~~unk,~~ unk, .56, .58, .31~~68~~, .44	19 (0.26~~35~~)
Mid-Atlantic Mid-water Trawl - Including Pair Trawl [c]	02~~1~~-06~~5~~	~~23,~~ 20, 23, 25, 31, 23	Obs. Data Weighout Trip Logbook	~~0,~~ .003, .018, .064, .084, .089	~~0,~~0,0,1,5, 3	~~unk,~~ unk, 51, 105, 97, 54	~~unk,~~ unk, .46, .38, .36~~76~~, .57	77~~84~~ (0.21~~34~~)
Mid-Atlantic Bottom Trawl[c]	~~01~~02-~~05~~06	unk	Obs. Data Weighout Trip Logbook	~~.01,~~ .01, .01, .03, .03, .02	~~0,~~ 0, 0, 0, 1, 0	~~27,~~ 25, 31, 26, 38, 26	~~.19,~~ .17, .25, .20, .29, .25	29 (.11)
Total								352~~7~~(0.09~~11~~)

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 two 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 2000-20052006. 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 during 2000-20052006. In addition, 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 and Northeast bottom trawl fisheries.
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, and 2005, and 2006.
e	There were two foreign vessels that harvested Atlantic herring in the U.S. fishery under a TALFF quota. During TALFF fishing operations all nets fished by the foreign vessel are observed.

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 1960's 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 between 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 is currently underway for Newfoundland fisheries using data collected during 2001 to 2003 (pers. comm. J. Lawson, DFO). White-sided dolphins were reported to have been 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.

Mass strandings involving up to a hundred or more animals at one time are common for this species. From 1968 to 1995, 349 Atlantic white-sided dolphins were known to have stranded on the New England coast (Hain and Waring 1994; Smithsonian stranding records 1996). 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. 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.

During 2002-2006 there were 325 documented Atlantic white-sided dolphin strandings on the US Atlantic coast (Table 3). X of these animals were released alive. Human interaction was indicated in 11 records during this

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period. Of these, 5 were classified as fishery interactions.

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. 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.

White-sided dolphin stranding records from 1997 that are in the NMFS/NE Regional Office strandings and entanglement database have been reviewed and updated. The most recent five years are reported in Table 3. Cause of death was investigated and it was determined that the documented human interactions were as follows: 1 animal possibly killed by a boat collision off Maine during 2001; 2 animals with indications of fishery interactions found in March 2002 in Massachusetts; and 1 animal with indications of fishery interactions found in May 2002 in Virginia, 1 animal with indications of fishery interactions was found in Massachusetts during 2004, and one animal during 2004 was found with twine blocking its esophagus (thus, this is a human interaction, but not necessarily a fishery interaction). 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. (Table 3).

Mass strandings in Massachusetts occur frequently (Table 3). There were 80 animals in a mass stranding near Wellfleet, Massachusetts, during the week of 29 January to 3 February 1998. Of these, 2 were released alive. Of the 4 found in Massachusetts during the November 1998 mass stranding, 1 was released alive. Fifty-three animals stranded in Wellfleet, Massachusetts during 19-24 March 1999. During 1999, of the 70 strandings, 38 were found alive, and 3 of these animals were released alive. During 2000, 5 were found alive (3 in April and 2 in August), and the 2 in August were released alive. During 2002, there were mass strandings in March and August, of which a few were released alive. During 2003 in Massachusetts 36 white-sided dolphins were involved in mass strandings in January, April and November, of which 25 were found alive. There were no mass strandings in 2004. In 2005 there were mass strandings in February, April, May and January. A total of 26 white-sided dolphins were involved in mass strandings, of which 11 were successfully released.

CANADA

Small numbers of white-sided dolphins have been taken 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 170km 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, 1 was found in Minas Basin, 2 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 (< 200cm), 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 2005 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), and 0 in 2005, and 1 in 2006.

Table 3. White-sided dolphin (*Lagenorhynchus acutus*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2002-2006.

Area						**Total**
	2002	2003	2004	2005	2006	
Maine	4	2	10	3	3	22

New Hampshire	_	_	_	1	_	1
Massachusetts[a,b]	53	59	34	60	49	255
Rhode Island	2	_	_	2	4	8
Connecticut	_	1	_	_	_	1
New York	1	2	1	_	3	7
New Jersey	1	1	1	6	1	10
Delaware	_	_	_	_	1	1
Maryland	_	_	_	1	1	2
Virginia[b]	1	_	4	3	3	11
North Carolina	_	1	2	3	1	7
TOTAL US	62	66	52	79	66	325
Nova Scotia	6	_	2	_	1	9
GRAND TOTAL	68	66	54	79	67	334

[a] Records of mass strandings in Massachusetts are: March 1999 - 53 animals; April 2000 - 5 animals; August 2000 - 11 animals; April 2001 - 6 animals; March 2002 - 31 animals, of which 7 were released alive; August 2002 - 3 animals, of which 1 was released alive; January 2003 - 4 animals; April 2003 - 28 animals; November 2003 - 4 animals; 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; and January 2006 4 separate events involving 23 animals (released alive); February 2006 2 events involving 1 and 5 animals; and July 2006 - 9 animals (7 released alive).

[b] Strandings that appear to involve a human interaction are: 1 animal from Virginia in May 2002 had signs of fishery interaction; 2 animals from Massachusetts in March 2002 had signs of fishery interactions; 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.

Table 3. White-sided dolphin (*Lagenorhynchus acutus*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2001-2005.

Area	Year					**Total**
	2001	2002	2003	2004	2005	
Maine[b]	2	4	2	10	3	21
New Hampshire	-	-	-	-	1	1
Massachusetts[a,b]	16	53	59	34	60	222
Rhode Island	-	2	-	-	2	4
Connecticut	-	-	1	-	-	1

New York	-	1	2	1	-	4
New Jersey	-	1	1	1	6	9
Delaware	-	-	-	-	-	0
Maryland	-	-	-	-	1	1
Virginia[b]	-	1	-	4	3	8
North Carolina	-	-	1	2	3	6
TOTAL US	18	62	66	52	79	277
Nova Scotia	3	6	-	2	-	8
GRAND TOTAL	21	68	66	54	79	285

[a] Records of mass strandings in Massachusetts are: March 1999 - 53 animals; April 2000 - 5 animals; August 2000 - 11 animals; April 2001 - 6 animals; March 2002 - 31 animals, of which 7 were released alive; August 2002 - 3 animals, of which 1 was released alive; January 2003 - 4 animals; April 2003 - 28 animals; November 2003 - 4 animals; 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, and December 2005 - 2 animals.

[b] Strandings that appear to involve a human interaction are: 1 animal from Maine in 2001 that was a possible boat collision; 1 animal from Virginia in May 2002 had signs of fishery interaction; 2 animals from Massachusetts in March 2002 had signs of fishery interactions; 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.

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. There are insufficient data to determine 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. This is a non-strategic stock because the 20012002-2005 2006 estimated average annual human related mortality does not exceed PBR.

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SHORT-BEAKED COMMON DOLPHIN (*Delphinus 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, tropical, and subtropical seas. In the North Atlantic, common dolphins occur over the continental shelf along the 200-2000 m isobaths and over prominent underwater topography from 50º N to 40º S latitude (Evans 1994). The species is less common south of Cape Hatteras, although schools have been reported as far south as eastern Florida (Gaskin 1992). In waters off the northeastern USA coast common dolphins are distributed along the continental slope (100 to 2,000 m) 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).

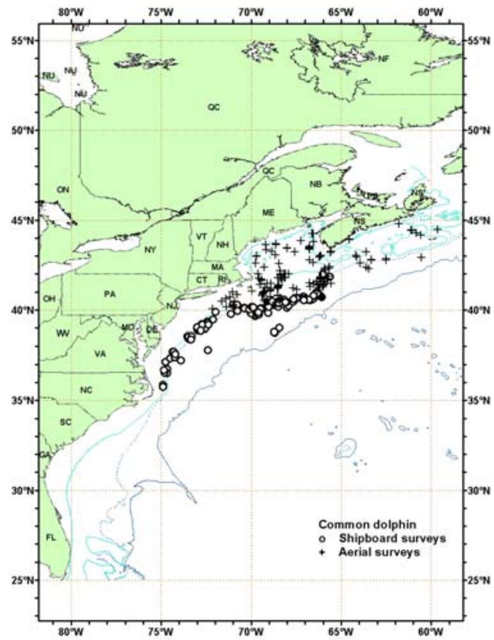

Figure 1. *Distribution of common dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

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 then 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 July 28th. Gestation lasts about 11.~~5~~ 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 (~~11~~ 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 the two surveys together have the most complete coverage of the species' habitat.

~~Earlier abundance estimates~~

~~An abundance estimate of 29,610 common dolphins (CV=0.39) was obtained from an aerial survey program conducted~~

~~from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 22,215 (CV=0.40) common dolphins was obtained from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). An abundance estimate of 1,645 (CV=0.47) common dolphins was obtained from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (NMFS 1993). An abundance estimate of 6,741 (CV=0.69) common dolphins was obtained from a July to September 1995 sighting survey conducted by two ships and an airplane that covered 32,600 km in waters from Virginia to the mouth of the Gulf of St. Lawrence. An abundance estimate of 30,768 (CV=0.32) common dolphins was generated from a line transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006). The SEFSC conducted a shipboard line transect sighting survey between 8 July and 17 August 1998, surveying 4,163 km of track line in waters south of Maryland (38ºN) and sighted no common dolphins (Mullin and Fulling 2003). Although the 1991, 1993, 1995, and 1998 surveys did not sample the same areas or encompass the entire common dolphin habitat (e.g., little effort in Scotian shelf edge waters), they did focus on segments of known or suspected high-use habitats off the northeastern USA coast. 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 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 data of 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 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).

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 ~~—~~> 50m) 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 ~~50x~~ 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, 2006; Buckland *et al.* 2001).

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.)

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

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, 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 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 ~~2001~~2002-~~2005~~ 2006 was 161 ~~151~~ (CV~~=.11~~=0.10) common dolphins (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 northeast coast of the U.S. With implementation of the Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA), an observer program was established which recorded fishery data and information on incidental bycatch of marine mammals. During the period 1977-1986, observers recorded 123 mortalities in foreign *Loligo* squid-fishing activities. No mortalities were reported in foreign *Illex* squid fishing operations.

From 1977 to 1991, observers recorded 110 mortalities in foreign mackerel-fishing operations (Waring *et al.* 1990; NMFS unpublished data). This total includes one documented take by a U.S. vessel involved in joint-venture fishing operations. A U.S. joint venture (JV) mackerel fishery was conducted in the mid-Atlantic region from February-May 1998. Seventeen incidental takes of common dolphin were observed in this fishery.

In the Atlantic pelagic longline fishery between 1990 and ~~2005~~2006, 20 common dolphins were observed hooked and released alive.

Eight hundred and sixty-one common dolphin mortalities were observed between 1989 and 1998 in the pelagic drift gillnet fishery, resulting in an estimated annual mortality and serious injury attributable to this fishery of (CV in parentheses) 540 in 1989 (0.19), 893 in 1990 (0.18), 223 in 1991 (0.12), 227 in 1992 (0.09), 238 in 1993 (0.08), 163 in 1994 (0.02), 83 in 1995 (0), 106 in 1996 (0.07) and 255 in 1998 (0).

Twelve mortalities were observed in the pelagic pair trawl between 1991 and 1995. The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 5.6 in 1991 (0.53), 32 in 1992 (0.48), 35 in 1993 (0.43), 0 in 1994 and 5.6 in 1995 (0.35).

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.

~~No common dolphins were taken in observed mid-Atlantic gillnet fishery trips during 1993 and 1994. Two common dolphins were observed taken in 1995, 1996 and 1997, and no takes were observed from 1998 to 2004. 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 1998-2004.~~

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

Northeast Sink Gillnet

Four common dolphins were observed taken in northeast sink gillnet fisheries in 2005 and one in 2006. 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 ~~and~~, 5 (0.80) in 2005, and 20 (1.05) in 2006. The 2002-2006 average mortality attributed to the northeast sink gillnet was 9 animals (CV=0.64). 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.

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. 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, and 11 (1.03) in 2006. Average annual estimated fishery-related mortality attributable to this fishery during 2002-2006 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, three in 2004, ~~and~~ five in 2005, and 1 in 2006. (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, ~~and~~ 32 (0.28) in 2005, and 25 in 2006. The ~~2001~~2002-~~2005~~ 2006 average mortality attributed to the northeast bottom trawl was ~~28~~27 animals (CV=0.13).

Mid-Atlantic Bottom Trawl

Three common dolphins were observed taken in mid-Atlantic bottom trawl fisheries in 2000, two in 2001, nine in 2004, ~~and~~ 15 in 2005, and 14 in 2006 (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, ~~and~~ 141 (0.29) in 2005, and 131 (0.28) in 2006. The ~~2001~~2002-~~2005~~ 2006 average mortality attributed to the mid-Atlantic bottom trawl was ~~118~~ 123 animals (CV=0.~~13~~12).

Table 2. Summary of the incidental mortality of short-beaked common dolphins (*Delphinus delphis*) 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 [a]	Years	Vessels	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	~~01~~02-~~05~~06	unk	Obs. Data Weighout, Logbooks	~~.04,~~ .02, .03, .06, .07, .04	0, 0, 0, 0, 0	~~0,~~ 0, 0, 0, 4, 1	0, 0, 0, 0, 0,	~~0,~~ 0, 0, 0, 26, 20	~~0,~~ 0, 0, 0, 26, 20	~~0,~~ 0, 0, 0, .8, 1.05	~~5~~ 9 (0.~~8~~64)
Mid-Atlantic Gillnet	02-06	unk	Obs. Data, Weighout	.01, .01, .02, .03, .04	0, 0, 0, 0, 0	0, 0, 0, 0, 1	0, 0, 0, 0, 0	0, 0, 0, 0, 11	0, 0, 0, 0, 11	0, 0, 0, 0, 1.03	2 (1.03
Northeast Bottom Trawl[d]	~~01~~02-~~05~~ 06	unk	Obs. Data Dealer Data VTR Data	~~.01,~~ .03, .04, .05, .12, .06	0, 0, 0, 0, 0	~~0,~~ 1, 0, 3, 5, 1	0, 0, 0, 0, 0	~~30,~~ 26, 26, 26, 32, 25	~~30,~~ 26, 26, 26, 32, 25	~~.30,~~ .29, .29, .29, .28, .28	~~28~~ 27 (.~~13~~13)
Mid-Atlantic Bottom Trawl[d]	~~01~~02-~~05~~ 06	unk	Obs. Data Dealer	~~.01,~~ .01, .01, .03 , .03, .02	0, 0, 0, 0 , 0	~~2,~~ 0, 0, 9, 15, 14	0, 0, 0, 0, 0	~~103,~~ 87, 99, 159, 141, 131	~~103,~~ 87, 99, 159, 141, 131	~~.27,~~ .27, .28, .30, .20, .28	~~118~~ 123 (.~~13~~12)
TOTAL											~~151~~ 161 (.~~11~~10)

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 and mid-Atlantic bottom trawl fishery coverages are ratios based on trips.

d. A new method was used to develop estimates of mortality for the Mid-Atlantic and Northeast bottom trawl fisheries during 2000-2006. 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 during 2000-2006. NE and MA bottom trawl mortality estimates reported for 2006 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2006 effort. This assumes that fishing practices during 2006 were consistent with fishing practices during the 2000-2005 time period. Complete documentation of methods used to estimate cetacean bycatch mortality are described in 'Estimated Bycatch of Cetaceans in Northeast U.S. Bottom Trawl Fishing Gear' but is not available for distribution. The manuscript is expected to be published in 2008. In addition, 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 and Northeast bottom trawl fisheries.~~d. The data used to predict bycatch rates to estimate annual mortality were pooled over the years 2001-2005. The data are treated as one data set and assumed to represent average fishing practices during the time period. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one given year, this does not imply that there was no bycatch during that year. The exception would be if year was selected by the model as an important factor associated with observing bycatch.~~

~~e A new method was used to develop preliminary estimates of mortality for the Mid-Atlantic and Northeast bottom trawl fisheries during 2000-2005. 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 during 2000-2005.~~

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 ~~1~~ one common dolphin. The incidental mortality rate for common dolphins was 0.007/set.

Other Mortality

From ~~2001~~ 2002 to ~~2005~~2006, ~~322~~ ~~375~~402 common dolphins were reported stranded between Maine and Florida (Table 3). The total includes mass stranded common dolphins in Massachusetts during 2002 (~~9~~ 12 animals), 2004 (one event of 6 animals and one of 3 animals), ~~and~~ a total of ~~25~~~~45~~43 in 2005 in ~~4~~ ~~5~~ 4 separate events~~;~~, and a total of 65 in 2006 in 10 events. ~~and in North Carolina in 2001 (7 animals).~~ Five of the 2005 Massachusetts stranded animals and ~~16~~18 animals in 2006 were released alive. ~~One stranded common dolphin calf in New Jersey was relocated to a rehabilitation facility in 2005. In 2001, one stranding mortality in Virginia and another animal in North Carolina were designated as human interactions/fishing interactions. Similarly i~~In 2002, one stranding in New York and another animal in Virginia were designated as human interactions/fishery interactions. Common dolphins were included in the UME (unusual mortality event) declared for Virginia in 2004 (Marine Mammal Commission 2005). The strandings were primarily bottlenose dolphins, but common dolphins were also involved. Human interactions were ~~implicated~~ indicated ~~in~~ on one of the 2004 Virginia common dolphin mortality records~~ies~~, one of the 2005 New York mortality records and one of the 2006 Virginia mortality records. ~~In 2005, one stranding mortality in New York was designated as human interaction.~~

Four common dolphin strandings (6 individuals) were reported on Sable Island, Nova Scotia from 1996 to 1998 (Lucas and Hooker 1997; Lucas and Hooker 2000). One common dolphin was reported stranded in Halifax County, Nova Scotia in 2005 (Tonya Wimmer, pers. comm.).

Table 3. Short-beaked common dolphin (*Delphinus delphis*) reported strandings along the U.S. Atlantic coast, 2002-2006.

STATE	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTALS**
Maine	0	0	0	0	0	0
Massachusetts[a]	34	~~21~~22	26	~~59~~6~~2~~4	~~8497~~100	~~224~~2~~41~~36
Rhode Island	1	2	1	0	2	6
Connecticut	0	0	0	0	0	0
New York[b, c]	5	11	3	4	~~2~~3	~~25~~26
New Jersey	1	6	~~8~~17	~~5~~4	2	~~22~~30
Delaware	1	1	2	1	0	5
Maryland	0	0	~~4~~5	0	0	~~4~~5
Virginia[b, c]	3	4	8	2	1	18
North Carolina	0	62	4	1	2	69
Georgia	0	0	0	0	0	0
Florida	1	0	0	0	0	1
EZ	0	0	1	0	0	1
TOTALS	46	~~107~~108	~~57~~67	~~72~~746	~~93~~1~~07~~10	~~375402~~397

a. Massachusetts mass strandings (2002 - 9 animals; 2004 - 6 and 3; 2005 - 7,5,25, and 4; 2006 - 2,2,3,4,4,3,9,10,14, and 14).

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.

c. 2002 FI, one in New York, one in Virginia. One 2005 mortality in New York reported as having human interaction and one in VA in 2006.

Table 3. Common dolphin (*Delphinus delphis*) reported strandings along the U.S. Atlantic coast, 2001-2005.

STATE	2001	2002	2003	2004	2005	TOTALS
Maine	1	0	0	0	0	1
Massachusetts[a]	8	34	21	26	59	148
Rhode Island	0	1	2	1	0	4
Connecticut	0	0	0	0	0	0
New York	6	5	11	3	4	29
New Jersey	5	1	6	8	4	24
Delaware	1	1	1	2	1	6
Maryland	2	0	0	4	0	6
Virginia[b]	4	3	4	8	2	21
North Carolina[d]	14	0	62	4	1	81
Georgia	0	0	0	0	0	0
Florida	0	1	0	0	0	1
EZ	0	0	0	1	0	1
TOTALS	41	46	107	57	71	322

a. Massachusetts mass strandings (2002 - 9 animals; 2004 - 6 and 3; 2005 - 7,5,25, and 4).
b. Virginia reports 1 common dolphin found in a pound net in 2004.
c. Fishery Interactions (FI)/Human Interactions (HI) - North Carolina reported 1 HI, fishing gear, April 2001; Virginia - 1 FI March 2001).
d. North Carolina mass stranding (2001 - 7 animals).
e. 2002 FI, one in NY, one in Va.

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 20012002-2005 2006 average annual human-related mortality does not exceed PBR; therefore, this is not a strategic stock.

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ROUGH-TOOTHED DOLPHIN *(Steno bredanensis)*: Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of the rough-toothed dolphin (*Steno bredanensis*) is poorly understood worldwide. These dolphins are thought to be a tropical to warm-temperate species, and historically have been reported in deep oceanic waters in the Atlantic, Pacific, and Indian oceans and the Mediterranean and Caribbean seas (Perrin and Walker 1975; Leatherwood and Reeves 1983; Reeves *et al.* 2003; Gannier and West 2005). Rough-toothed dolphins have, however, been observed in both shelf and oceanic waters in the northern Gulf of Mexico, and off Japan, Brazil, and Mauritania (Maigret *et al*. 1976; Miyazaki 1980; Lodi and Hertzel 1999; Addink and Smeenk 2001; Fulling *et al.* 2003; Mullin and Fulling 2004; Gannier and West 2005). In French Polynesia, rough-toothed dolphins were observed in deep waters, but were more commonly distributed inshore than offshore (Gannier and West 2005). Ritter (2002) observed rough-toothed dolphins in the Canary Islands in waters from 20 m to 2,500 m, with the average depth reported as 506 m and surface water temperatures ranging from 17° to 24°C. Rough-toothed dolphins have been reported feeding in waters off Brazil ranging from 5 m to 39 m in depth, with surface temperatures between 22°to 24°C (Lodi and Hetzel 1999). Sightings of rough-toothed dolphins along the East Coast of the U.S. are much less common than in the Gulf of Mexico (CETAP 1982; National Marine Fisheries Service 1999; Mullin and Fulling 2003).

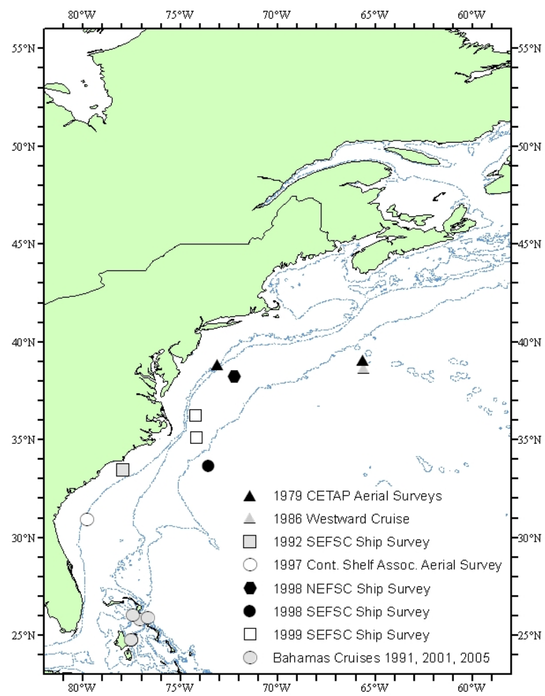

Figure 1. *Distribution of rough-toothed dolphin sightings from 1979 - 2005. Isobaths are at 100 m, 1,000 m, and 4,000 m.*

In the western North Atlantic, tracking of five rough-toothed dolphins which were rehabilitated and released following a mass stranding on the east coast of Florida in 2005, demonstrated a variety of ranging patterns (Wells et al. in review). All tagged rough-toothed dolphins moved through a large range of water depths averaging greater than 100 m, though each of the five tagged dolphins transited through very shallow waters at some point, with most of the collective movements recorded over a gently sloping sea floor. These five rough-toothed dolphins moved through waters ranging from 17° to 31°C, with temperatures averaging 21° to 30°C. Recorded dives were rarely deeper than 50 m, with the tagged dolphins staying fairly close to the surface. Three rehabilitated rough-toothed dolphins released with tags near Ft. Pierce, Florida in March 2005 were tracked in waters averaging 1,100 m in depth with sea surface temperatures averaging 24°C during the first week of tracking, moving to waters of 19°C (Wells and Gannon 2005). Rehabilitated rough-toothed dolphins released and tracked in the northeast Gulf of Mexico in 1998 were recorded in waters with an average depth of 195 m and an average sea surface temperature of 25°C, typically over or near an escarpment (Wells et al. 1999). It is not known how representative of normal species patterns any of these movements are.

Although Miyazaki and Perrin (1994) describe these dolphins as a "diving species," dives of more than 3 minutes duration were rare for the tagged dolphins (Wells and Gannon 2005; Wells et al. 1999; Wells et al. in review), similar to behavior reported for this species by Lodi and Hetzel (1999) and Ritter (2002).

These dolphins are typically seen in small groups of 10-20 animals (Wade and Gerrodette 1993; Jefferson 2002; Reeves *et al.* 2003; Waring *et al*. 2007). Larger groups have been recorded, namely groups of 45 animals in the

Atlantic (CETAP 1982), over 50 animals in the eastern tropical Pacific, 99 animals in the Caribbean (Swartz *et al.* 2001), 160 animals in the Mediterranean, and 300 animals off Hawaii (Miyazaki and Perrin 1994).

Tagging studies of rehabilitated and released rough-toothed dolphins, as well as field observations, indicate that social bonds between members of a group may be strong. Two rough-toothed dolphins tagged and released in the Gulf of Mexico in 1998 were observed together 157 after release (Wells et al. 1999). Three rough-toothed dolphins released together near Ft. Pierce, Florida in 2005 exhibited frequent social interactions including food sharing, epimeletic care-giving behavior and whistle exchanges and were seen together throughout the tracking period of at least 20 days (Wells and Gannon 2005). Similar complex social behaviors have also been reported for this species off the Canary Islands (Ritter 2002, 2007), Brazil (Lodi 1992; de Moura *et al*. 2008), and Honduras (Kuczaj and Yeater 2007). Photo-identification techniques suggest resident populations may exist off the coast of Utila, Honduras (Kuczaj and Yeater 2007), in the Mediterranean Sea near Sicily (Reeves *et al.* 2003), and off the Canary Islands (Ritter 2001, 2007).

For management purposes, rough-toothed dolphins observed off the eastern U.S. coast are provisionally considered a separate stock from dolphins recorded in the northern Gulf of Mexico, although there is currently no information to differentiate these stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The number of rough-toothed dolphins off the eastern U.S. and Canadian Atlantic coast is unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen during surveys. With one exception, sightings were exclusively over or seaward of the continental slope north of the Bahamas (Figure 1). Though abundance estimates have been calculated in some cases, given the paucity of sightings as well as limited survey effort in deep, offshore areas, an accurate abundance estimate has not been made, and therefore the population size of rough-toothed dolphins in the western North Atlantic is presently considered unknown.

Rough-toothed dolphins were seen only twice during the Cetacean and Turtle Assessment Program (CETAP) surveys conducted from 1978 to 1982 in continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). Twenty probable rough-toothed dolphins were seen from the U.S. Coast Guard cutter *Cherokee* during the CETAP Platform of Opportunity Program (POP) in June 1979. In September 1979, 45 rough-toothed dolphins were observed from the Russian R/V *Belagorsk*. No abundance estimate was made based on these two sightings.

A sighting of 9 rough-toothed dolphins was made from the R/V *Westward* in June 1986 during an opportunistic cruise (Kenney pers. comm.). In January 1992, 6 rough-toothed dolphins were reported during a SEFSC aerial survey. Three rough-toothed dolphins were observed on 5 March 1997 during an aerial survey conducted by Continental Shelf Associates (Kenney pers. comm.).

Eight rough-toothed dolphins were seen on 28 July 1998 during a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38°N) (Mullin and Fulling 2003). An abundance estimate of 274 (CV=1.03) was calculated based on this one sighting.

Three rough-toothed dolphins were observed from a ship in July 1998 during a line-transect sighting survey conducted from 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006). An abundance estimate of 30 (CV=0.86) was calculated based on this one sighting.

Two groups of rough-toothed dolphins were observed during a vessel survey of the western North Atlantic off Cape Hatteras, North Carolina in waters greater than 2,500 m deep (National Marine Fisheries Service 1999). Four rough-toothed dolphins were seen in August 1999, and 20 rough-toothed dolphins were seen in September 1999. No abundance estimate was made based on these two sightings.

Recent surveys and abundance estimates

There have been no sightings of rough-toothed dolphins during shipboard or aerial surveys since 1999, except in the Caribbean, despite survey cruises conducted in areas where previous sightings of this species had been made. Survey effort in deep, offshore areas off the eastern U.S. coast and in the Caribbean, where this species may occur with more frequency, has, however, been limited.

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 population trends for this stock.

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 unknown. 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 this stock is of unknown status. PBR for the western North Atlantic stock of rough-toothed dolphins is unknown, due to an unknown minimum population size.

ANNUAL HUMAN-CAUSED MORTALITY

Fishery Information

Detailed fishery information is reported in Appendix III. No rough-toothed dolphins have been reported as bycatch in any of these fisheries (Garrison 2003, 2005; Garrison and Richards 2005; Fairfield-Walsh and Garrison 2006, 2007; Palka, pers. com.). Total annual estimated average fishery-related mortality and serious injury to this stock during 2002-2006 was zero rough-toothed dolphins, as there were no reports of mortality or serious injury to this stock.

Rough-toothed dolphins have been taken incidentally in the tuna purse seine nets in the eastern tropical Pacific, and in gill-nets off Sri Lanka, Brazil and the offshore North Pacific (Jefferson 2002), though no incidental takes have been reported off the eastern U.S. coast. A small number of this species are taken in directed fisheries in the Caribbean countries of St. Vincent and the Lesser Antilles, as well as in countries in the Pacific and eastern north Atlantic Oceans (Argones 2001; Jefferson 2002; Northridge 1984; Reeves *et al.* 2003).

Other Mortality

From 2002 to 2006, 146 rough-toothed dolphins were reported stranded between Maine and Puerto Rico (Table 2). Human interaction was recorded for two dolphins that stranded in North Carolina in 2006, though specific details of the type of interaction were not recorded. Although rarely observed at sea in the southeastern U.S., this species accounts for 34% of the reported mass strandings involving 5 or more animals in the past 10 years. The majority of these occurred along the Atlantic coast of Florida and Georgia and the Gulf coast of Florida (National Marine Fisheries Service 2008, Table 1).

Table 2. Rough-toothed dolphin (*Steno bredanensis*) strandings along the U.S. Atlantic coast (2002-2006).

STATE	2002	2003	2004	2005	2006	TOTALS
Virginia	14[1]	0	0	0	0	14
North Carolina	0	0	0	0	2	2
Georgia	0	17[2]	0	0	0	17
Florida	1	2	37[3]	70[4]	1	111
Puerto Rico	0	2	0	0	0	2
TOTALS	15	21	37	70	3	146

[1]Mass live stranding of 14 animals in Northampton, VA in July 2002.
[2]Mass live stranding of 17 animals in Glynn, GA in July 2003.
[3]Mass live stranding of 37 animals in St. Lucie, FL in August 2004.
[4]Mass live stranding of 69 animals in March 2005 in Marathon, FL.

At least thirty-six rough-toothed dolphins stranded on Hutchinson Island in St. Lucie County, Florida on 6 August 2004, and another one live-stranded on 8 August 2004. Due to severe weather, the animals were walked to chest-high water and released simultaneously. The dolphins restranded later the same evening 5.6 km to the north. Thirty dolphins were euthanized on site, and seven were taken to a rehabilitation facility. Four of the dolphins died in rehabilitation and three were released on 3 March 2005 with satellite transmitters 29 km east of Ft. Pierce, Florida. All three dolphins remained together and were last recorded off the Virginia/North Carolina coast. Two of the 37 dolphins showed signs of human interaction – one had a plastic bottle cap in its fore-stomach, while the second animal had black plastic in its fore-stomach.

On 2 March 2005, at least 69 rough-toothed dolphins mass-stranded alive on the Atlantic Ocean side of Marathon Island in the Florida Keys, though additional animals may have swam away or not been recovered. Fifty-six animals (41 females and 15 males) were evaluated for rehabilitation candidacy, 10 of which died naturally and 14 were euthanized on site. The remaining 32 dolphins were transferred to three rehabilitation facilities, though 12 of these dolphins died during rehabilitation. No evidence of human or fishery interaction was reported in any of the dolphins. A review of the potential causative factors for this mass stranding suggested that a transient environmental change, specifically a rapid change in near-shore water temperatures associated with a shift in wind direction, led an already nutritionally deficient group of dolphins into shallow water (National Marine Fisheries Service 2008). Once in this habitat, the dolphins were presumably unable to navigate their way back out, resulting in the stranding. There was no indication of significant health effects due to toxins associated with harmful algal blooms, there was no evidence of acoustic trauma and only very limited potential exposure to Naval active acoustic activity, nor was there any evidence that an infectious agent such as a parasite, bacteria, or virus resulted in significant health effects and contributed to the stranding event

Eleven rehabilitated dolphins from this stranding were tagged and released back into the Atlantic Ocean in continental slope waters, two on 20 April 2005 off Key Biscayne, Florida; seven on 3 May 2005 and two on 12 September 2005 off Key Largo, Florida. Ten dolphins were tagged with VHF or satellite-linked transmitters and were tracked for 12-49 days (Wells *et al*., in review). For the two releases involving multiple tagged dolphins, the individuals appeared to remain together through much, if not all, of the tracks (Lodi 1992; Miyazaki and Perrin 1994; Lodi and Hetzel 1999; Wells and Gannon 2005). Detailed information on this mass stranding is available in National Marine Fisheries Service (2008) and in the companion report on follow-up tracking (Wells *et al*. in review).

A potential human-caused source that may contribute to mortality for this species is from persistent organic pollutants (POPs), which were analyzed in 15 stranded rough-toothed dolphins from the Gulf of Mexico (Struntz *et al*. 2004). Although these dolphins exhibited lower concentrations of polychlorinated biphenyls (PCBs) than those observed in other species of dolphins including Risso's, striped and bottlenose dolphins sampled in Japan, the Mediterranean and the Gulf coast of Texas, respectively, the concentrations were above the toxic threshold for marine mammal blubber suggested by Kannan *et al.* 2000. Struntz *et al*. (2004) concluded it was "likely that PCBs pose a health risk for the population represented by this limited sample group." Plastic debris may also pose a threat to this, and other, species, as evidenced by a plastic bag found in the stomach of two stranded rough-toothed dolphins – one which stranded in 2004 in St. Lucie County Florida (see above), and one in northeastern Brazil (de Meirelles and Barros 2007), and a plastic bottle cap found in one of the dolphins which stranded in St. Lucie County, Florida in 2004 (see above).

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 rough-toothed 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 size or trends and PBR cannot be calculated for this stock. No fishery-related mortality and serious injury has been observed; therefore, total fishery-related mortality and serious injury can be considered insignificant and approaching zero mortality. This is not a strategic stock.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Western North Atlantic Offshore Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two morphologically and genetically distinct bottlenose dolphin morphotypes (Duffield *et al.* 1983; Duffield 1986) described as the coastal and offshore forms. Both inhabit waters in the western North Atlantic Ocean (Hersh and Duffield 1990; Mead and Potter 1995; Curry and Smith 1997) along the U.S. Atlantic coast. The two morphotypes are genetically distinct based upon both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). The offshore form is distributed primarily along the outer continental shelf and continental slope in the Northwest Atlantic Ocean; however the offshore morphotype has been documented to occur relatively close to shore over the continental shelf south of Cape Hatteras, NC.

Bottlenose dolphins which stranded alive in the western North Atlantic in areas with direct access to deep oceanic waters had hemoglobin profiles that matched that of the offshore morphotype (Hersh and Duffield 1990). Hersh and Duffield (1990) also described morphological differences between offshore morphotype dolphins and dolphins with hematological profiles matching the coastal morphotype which had stranded in the Indian/Banana River in Florida. North of Cape Hatteras, there is separation of the two morphotypes across bathymetry during summer months. Aerial surveys flown during 1979-1981 indicated a concentration of bottlenose dolphins in waters < 25 m deep corresponding to the coastal morphotype, and an area of high abundance along the shelf break corresponding to the offshore stock (CETAP 1982; Kenney 1990). Biopsy tissue sampling and genetic analysis demonstrated that bottlenose dolphins concentrated close to shore were of the coastal morphotype, while those in waters > 40 m depth were from the offshore morphotype (Garrison *et al.* 2003). However, during winter months and south of Cape Hatteras, NC the range of the coastal and offshore morphotypes overlap to some degree. Torres *et al.* (2003) found a statistically significant break in the distribution of the morphotypes at 34 km from shore based upon the genetic analysis of tissue samples collected in nearshore and offshore waters. The offshore morphotype was found exclusively seaward of 34 km and in waters deeper than 34 m. Within 7.5 km of shore, all animals were of the coastal morphotype. More recently, offshore morphotype animals have been sampled as close as 7.3 km from shore in water depths of 13 m (Garrison *et al.* 2003). Systematic biopsy collection surveys were conducted coastwide during the summer and winter between 2001~~-~~and 2005 to evaluate the degree of spatial overlap between the two morphotypes. Over the continental shelf south of Cape Hatteras, North Carolina the two morphotypes overlap spatially, and the probability of a sampled group being from the offshore morphotype increased with increasing depth based upon a logistic regression analysis (Garrison *et al*. 2003).

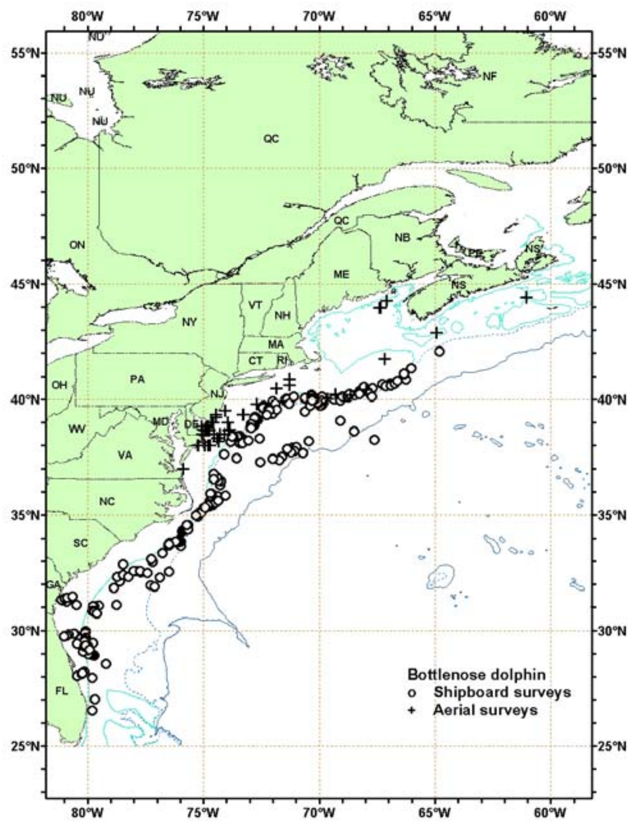

Figure 1. Distribution of bottlenose dolphin sightings from NEFSC and SEFSC aerial surveys during summer in 1998, 1999, 2002, 2004, and 2006. Isobaths are at 100 m, 1,000 m, and 4,000 m.

Seasonally, bottlenose dolphins occur over the outer continental shelf and inner slope as far north as

Georges Bank (Figure 1; CETAP 1982; Kenney 1990). Sightings occurred along the continental shelf break from Georges Bank to Cape Hatteras during spring and summer (CETAP 1982; Kenney 1990). In Canadian waters, bottlenose dolphins have occasionally been sighted on the Scotian Shelf, particularly in the Gully (Gowans and Whitehead 1995; NMFS unpublished data). The range of the offshore bottlenose dolphin ~~may~~ includes waters beyond the continental slope (Kenney 1990), and offshore bottlenose dolphins may move between the Gulf of Mexico and the Atlantic (Wells *et al.* 1999). Dolphins with characteristics of the offshore type have stranded as far south as the Florida Keys.

POPULATION SIZE

The best available estimate for offshore morphotype bottlenose dolphins is the sum of the estimates from the ~~summer~~ June-July 2002 aerial survey covering the continental shelf, the summer 2004 vessel survey south of Maryland, and the summer 2004 vessel and aircraft surveys north of Maryland. This joint estimate provides complete coverage of the offshore ~~morphotype~~ habitat from central Florida to Canada during summer months. The combined abundance estimate from these surveys is 81,588 (CV = 0.17).

Earlier abundance estimates

An abundance of 16,689 (CV=0.32) bottlenose dolphins was estimated from a line-transect sighting survey conducted during July 6 to September 6, 1998, by a ship and plane that surveyed 15,900 km of trackline in waters north of Maryland (38˚ N) (Figure 1; Palka, unpublished). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and g(0), the probability of detecting a group on the track line. Aerial data were not corrected for g(0). An abundance of 13,085 (CV=0.40) for bottlenose dolphins was obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38˚N) (Fig. 1; Mullin and Fulling 2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 2001; Thomas *et al.* 1998) where school size bias and ship attraction were accounted for.

Recent surveys and abundance estimates

During the summer (June - July) of 2002, aerial surveys covering a total of 6,734 km of trackline were conducted along the U.S. Atlantic coast between Ft. Pierce, Florida and Sandy Hook, New Jersey. ~~A total of 6,734 km of trackline were completed during the summer survey between Sandy Hook, NJ and Ft. Pierce, FL.~~ The abundance of bottlenose dolphins in survey strata was obtained using line-transect methods and distance analysis, and the direct duplicate estimator was used to account for visibility bias (Buckland *et al.* 2001; Palka 1995). These estimates were further partitioned between the coastal and offshore morphotypes based upon the results of the logistic regression models and spatial analyses described above. A parametric bootstrap approach was used to incorporate the uncertainty in the logistic regression models into the overall uncertainty in the abundance estimate for offshore bottlenose dolphins (Garrison *et al.* 2003). The resulting coastwide abundance estimate for the offshore morphotype in waters < 40 m depth was 26,849 (CV = 0.193).

An abundance of 9,786 (CV = 0.56) for offshore morphotype bottlenose dolphins was estimated from a line-transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of 38˚ N (Table 1; Palka 2005). 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).

An estimate of abundance ~~for~~ obtained from an aerial survey conducted in August 2002 was 5,100 (CV=0.41) offshore morphotype bottlenose dolphins and an abundance estimate of 2,989 (CV=1.11) was obtained from a survey conducted in ~~for~~ August 2006. The ~~summer of~~ 2002, 2006 and part of the above 2004 sighting surveys were conducted on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from the three aerial surveys, while the density estimates were year-specific. The 2006 survey covered 10,676 km of trackline in the region from the 2000m 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. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern edge of Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered 6,180 km of trackline in the region from the 100m depth contour on the southern edge of Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths < 50m) between 27.5 – 38ºN latitude was conducted during June-August, 2004. The survey employed two independent visual teams searching with "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 there were 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 offshore morphotype bottlenose dolphins between Florida and Maryland was 44,953 (CV = 0.26).

Table 1. Summary of abundance estimates for western North Atlantic offshore stock of bottlenose 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
Jun-Jul 2002	New Jersey to Florida	26,849	0.19
Aug 2002	S. Gulf of Maine to Maine	5,100	0.41
Jun-Aug 2004	Maryland to Bay of Fundy	9,786	0.56
Jun-Aug 2004	Florida to Maryland	44,953	0.26
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	2,989	1.11

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 minimum population estimate for western North Atlantic offshore bottlenose dolphin is 70,775.

Current Population Trend

The data are insufficient to determine population trends. Previous estimates cannot be utlized to assess trends because previous survey coverage of the species' habitat was incomplete.

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 for offshore bottlenose dolphins is 70,775. 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 0.4 because this stock is of unknown status and due to the high degree of uncertainty in bycatch estimates (CV can not be calculated). PBR for the western North Atlantic offshore bottlenose dolphin is therefore 566.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual human-caused mortality and serious injury of offshore bottlenose dolphins is unknown,

Fisheries Information

Total estimated mean annual fishery-related mortality for this stock during 2001-~~2005~~ 2006 is unknown, however mortalities of offshore bottlenose dolphins were observed during this period in the Northeast Sink Gillnet and ~~Mid~~mid-Atlantic Gillnet commercial fisheries. 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 northeast 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 Magnuson Fisheries Conservation and Management Act (MFCMA).

Bottlenose dolphin mortalities were observed in the pelagic drift gillnet fishery in 1989-1998. Bycatch mortality estimates extrapolated for each year (CV in parentheses) were 72 in 1989 (0.18), 115 in 1990 (0.18), 26 in 1991 (0.15), 28 in 1992 (0.10), 22 in 1993 (0.13), 14 in 1994 (0.04), 5 in 1995 (0), 0 in 1996, and 3 in 1998 (0).

Thirty-two bottlenose dolphin mortalities were observed in the pelagic pair trawl fishery between 1991 and 1995. Estimated annual fishery-related mortality (CV in parentheses) was 13 dolphins in 1991 (0.52), 73 in 1992 (0.49), 85 in 1993 (0.41), 4 in 1994 (0.40) and 17 in 1995 (0.26).

Although there were reports of bottlenose dolphin mortalities in the foreign squid mackerel butterfish fishery during 1977-1988, there were no fishery-related mortalities of bottlenose dolphins reported in the self-reported fisheries information from the mackerel trawl fishery during 1990-1992.

One bottlenose dolphin mortality was documented in the North Atlantic bottom trawl in 1991 and the total estimated mortality in this fishery in 1991 was 91 (CV=0.97). Since 1992 there were no bottlenose dolphin mortalities observed in this fishery.

Pelagic Longline

The pelagic longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ (SEFSC unpublished data). Between 1992 and ~~2005~~ 2006 in Atlantic waters, one bottlenose dolphin was observed caught and released alive during 1993, and one was caught and released alive during 1998. In addition, one bottlenose dolphin was observed taken and released alive ~~and uninjured~~ in 2005 near the continental shelf break south of Cape Hatteras, NC. No bottlenose dolphin mortalities or serious injuries were observed between ~~2001~~ 2002 and ~~2005~~ 2006 (Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield-Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Northeast Sink Gillnet

The first observed mortality of bottlenose dolphins was recorded in 2000. This was genetically identified as an offshore morphotype animal. The estimated annual fishery-related serious injury and mortality attributable to this fishery (CV in parentheses) was 0 from 1996-1999, and 132 (CV=1.16) in 2000. There was one additional observed mortality of a bottlenose dolphin presumed to be from the offshore morphotype in this fishery during 2004. Total mortality estimates for ~~2001~~2002-~~2005~~ 2006 have not been calculated (Table 2).

Mid-Atlantic Gillnet

Bottlenose dolphin mortalities were observed in this fishery during 1998, 2001, and 2005. In each case, the dolphin was presumed to be of the offshore morphotype based upon its location in deep water over the outer continental shelf. The only prior estimate of total mortality in the fishery was 4 (CV = 0.7) for 1998. Extrapolated estimates of total mortality from ~~2001~~2002~~-~~ to~~2005~~ 2006 have not been calculated (Table 2).

Table 2. Summary of the incidental mortality of offshore morphotype bottlenose dolphins (*Tursiops truncatus*) 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	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	~~01~~02-~~05~~06	unk[c]	Obs. Data Dealer Reports, Logbooks	~~.04,~~ .02, .03, .06, .07, .04	~~0,~~ 0, 0, 1, 0, 0	~~0,~~ 0, 0, unk[d], ~~unk[d]~~ 0, 0	~~0,~~ 0, 0, unk[d], 0, 0	unk[d]
Mid-Atlantic Gillnet	~~01~~02-~~05~~06	unk[c]	Obs. Data Dealer Reports	~~.02,~~ .01, .01, .02, .03, .04	~~0,~~ 0, 0, 0, 1, 0	~~unk[d],~~ 0, 0, 0 unk[d], 0	~~unk[d],~~ 0, 0, 0, unk[d], 0	unk[d]

a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected by the Northeast Fisheries Observer Program. The NEFSC collects landings data (Dealer Reports), and total landings are used as a measure of total effort for the gillnet fisheries. Mandatory vessel trip reports (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery.

b. Observer coverage of the Northeast sink gillnet and mid-Atlantic coastal gillnet fisheries are ratios based on the percentage of tons of fish landed.

c. Number of vessels is not known.

d. Estimates of bycatch mortality attributed to the Northeast sink gillnet and Mid-Atlantic gillnet fisheries have not been generated

Other Mortality

Bottlenose dolphins are among the most frequently stranded small cetaceans along the Atlantic coast. Many of the animals show signs of human interaction (*i.e.*, net marks, mutilation, etc.); however, it is unclear what proportion of these stranded animals is from the offshore morphotype.

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown. The western North Atlantic offshore bottlenose dolphin is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. Average ~~2001~~2002-~~2005~~ 2006 annual U.S. fishery-related mortality and serious injury ~~–~~has not been estimated, and it is therefore unknown whether or not total mortality and serious injury can be considered insignificant.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Western North Atlantic Coastal Morphotype Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

Geographic Range and Coastal Morphotype Habitat

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York around the Florida peninsula and along the Gulf of Mexico coast. Based on differences in mitochondrial DNA haplotype frequencies, nearshore animals in the northern Gulf of Mexico and the western North Atlantic represent separate stocks (Curry 1997; Duffield and Wells 2002). On the Atlantic coast, Scott *et al.* (1988) hypothesized a single coastal migratory stock ranging seasonally from as far north as Long Island, to as far south as central Florida, citing stranding patterns during a high mortality event in 1987-88 and observed density patterns. More recent studies demonstrate that the single coastal migratory stock hypothesis is incorrect, and there is instead a complex mosaic of stocks (NMFS 2001; McLellan *et al.* 2003).

The coastal morphotype is morphologically and genetically distinct from the larger, more robust morphotype primarily occupying habitats further offshore (Hoelzel *et al.* 1998; Mead & Potter 1995). Aerial surveys conducted between 1978 and 1982 (CETAP 1982) north of Cape Hatteras, North Carolina identified two concentrations of bottlenose dolphins, one inshore of the 25 m isobath and the other offshore of the 50 m isobath. The lowest density of bottlenose dolphins was observed over the continental shelf, with higher densities along the coast and near the continental shelf edge. It was suggested, therefore, that north of Cape Hatteras, North Carolina the coastal morphotype is restricted to waters < 25 m deep (Kenney 1990). Similar patterns were observed during summer months in more recent aerial surveys (Garrison and Yeung 2001; Garrison *et al*. 2003). However, south of Cape Hatteras during both winter and summer months, there was no clear longitudinal discontinuity in bottlenose dolphin sightings (Garrison and Yeung 2001; Garrison *et al.* 2003).

A combined spatial and genetic analysis of tissue samples from large vessel surveys during the summers of 1998 and 1999 indicated that bottlenose dolphins within 7.5 km from shore were most likely of the coastal morphotype, and there was a region of overlap between the coastal and offshore morphotypes between 7.5 and 34 km from shore south of Cape Hatteras (Torres *et al.* 2003). However, relatively few samples were available from the region of overlap, and therefore the longitudinal boundaries based on these initial analyses were uncertain (Torres *et al*. 2003). Extensive systematic biopsy sampling efforts were conducted in the summers of 2001 and 2002 to supplement collections from large vessel surveys. During the winters of 2002 and 2003, additional biopsy collection efforts were conducted in nearshore continental shelf waters of North Carolina and Georgia. Additional biopsy samples were collected in deeper continental shelf waters south of Cape Hatteras during winter 2002. Genetic analyses using mitochondrial DNA sequences of these biopsies identified individual animals to the coastal or offshore morphotype. Using the genetic results from all surveys combined, a logistic regression was used to model the probability that a particular bottlenose dolphin group was of the coastal morphotype as a function of environmental variables including depth, sea surface temperature, and distance from shore. These models were used to partition the bottlenose dolphin groups observed during aerial surveys between the two morphotypes (Garrison *et al*. 2003).

The genetic results and spatial patterns observed in aerial surveys indicate both regional and seasonal differences in the longitudinal distribution of the two morphotypes in coastal Atlantic waters. During summer months, all biopsy samples collected from nearshore waters north of Cape Lookout, North Carolina (< 20 m deep) were of the coastal morphotype, and all samples collected in deeper waters (> 40 m deep) were of the offshore morphotype. South of Cape Lookout, the probability of an observed bottlenose dolphin group being of the coastal morphotype declined with increasing depth. In intermediate depth waters, there was spatial overlap between the two morphotypes. Offshore morphotype bottlenose dolphins were observed at depths as shallow as 13 m, and coastal morphotype dolphins were observed at depths of 31 m and 75 km from shore (Garrison *et al*. 2003).

Winter samples were collected primarily from nearshore waters in North Carolina and Georgia. The vast majority of samples collected in nearshore waters of North Carolina during winter were of the coastal morphotype; however, one offshore morphotype group was sampled during November just south of Cape Lookout only 7.3 km from shore. Coastal morphotype samples were also collected farther away from shore at 33 m depth and 39 km distance from shore. The logistic regression model for this region indicated a decline in the probability of a coastal morphotype group with increasing distance from shore; however, the model predictions were highly uncertain due to limited sample sizes and spatial overlap between the two morphotypes. Samples collected in Georgia waters also indicated significant overlap between the two morphotypes with a declining probability of the coastal morphotype with increasing depth. A coastal morphotype sample was collected 112 km from shore and a depth of 38 m. An offshore sample was collected in 22 m depth at 40 km from shore. As with the North Carolina model, the Georgia logistic regression predictions are uncertain due to limited sample size and high overlap between the two morphotypes (Garrison *et al.* 2003).

In summary, the primary habitat of the coastal morphotype of bottlenose dolphin extends from Florida to New Jersey during summer months and in waters less than 20 m deep, including estuarine and inshore waters. South of Cape Lookout, the coastal morphotype occurs in lower densities over the continental shelf (waters between 20 m and 100 m depth) and overlaps spatially with the offshore morphotype.

Distinction Between Coastal and Estuarine Bottlenose Dolphins

There are multiple lines of evidence supporting demographic separation between bottlenose dolphins residing within estuaries along the Atlantic coast. For example, long-term photo-identification studies in waters around Charleston, South Carolina have identified communities of resident dolphins that are seen within relatively restricted home ranges year-round (Zolman 2002; Gubbins 2002; Speakman *et al.* 2006). In Biscayne Bay, Florida there is a similar community of bottlenose dolphins with evidence of year-round residents that are genetically distinct from animals residing in a nearby estuary in Florida Bay (Litz 2007). The Indian River Lagoon system in central Florida also has a long photo-identification study, and this study identified year-round resident dolphins repeatedly observed across multiple years (Stolen *et al.* 2007). There are relatively few published studies demonstrating that these resident animals are genetically distinct from animals in nearby coastal waters; however, a study conducted near Jacksonville, Florida demonstrated significant genetic differences between animals in nearshore coastal waters and estuarine waters (Caldwell 2001). In addition, stable isotope analysis of animals sampled along the Outer Banks of North Carolina between Cape Hatteras and Bogue Inlet during February and March shows very low stable isotope ratios of ^{18}O relative to ^{16}O (referred to as depleted ^{18}O or depleted oxygen, Cortese 2000). One explanation for the depleted oxygen signature is a resident group of dolphins in Pamlico Sound that move into nearby nearshore areas in the winter. The possibility of a resident group of bottlenose dolphins in Pamlico Sound is also supported by results from satellite telemetry and photo-identification (NMFS 2001). Long-term, year-round, multi-generational resident communities of dolphins have been recognized in embayments and coastal areas of the Gulf of Mexico (Wells *et al.* 1987; Wells *et al.* 1996; Scott *et al.* 1990; Weller 1998; Wells 2003), and it is not surprising to find similar patterns along the Atlantic coast.

Given the observed patterns of residency across multiple estuaries along the Atlantic coast and the evidence of demographically distinct estuarine stocks in the Gulf of Mexico (e.g., Wells 2003), it is highly likely that there is demographic separation between bottlenose dolphins residing within estuaries and those in nearshore coastal waters. However, the degree of spatial overlap between these populations remains unclear. Photo-identification studies within estuaries demonstrate seasonal immigration and emigration and the presence of transient animals (e.g., Speakman *et al.* 2006). In addition, the degree of movement of resident estuarine animals into coastal waters on seasonal or shorter time scales is poorly understood. However, for the purposes of this analysis, bottlenose dolphins inhabiting primarily estuarine habitats are considered distinct from those inhabiting coastal habitats. Bottlenose dolphin stocks inhabiting coastal waters are the focus of this report.

Definition of Coastal Stocks

Initially, a single stock of coastal morphotype bottlenose dolphins was thought to migrate seasonally between New Jersey (summer months) and central Florida based on seasonal patterns in strandings during a large scale mortality event occurring during 1987-1988 (Scott *et al.* 1988). However, re-analysis of stranding data (McLellan *et al.* 2003) and extensive analysis of genetic, photo-identification, satellite telemetry, and stable isotope studies demonstrate a complex mosaic of coastal bottlenose dolphin stocks (NMFS, 2001). In the northern part of the range, the patterns reported include seasonal residency, year-round residency with large home ranges, and migratory or transient movements (Barco and Swingle 1996). There are strong seasonal differences in the spatial distribution of bottlenose dolphins in coastal waters. North of Cape Lookout, North Carolina, bottlenose dolphins were observed along the North Carolina coast and as far north as Long Island, New York during summer months (CETAP 1982, Kenney 1990, Garrison *et al.* 2003). During winter months, bottlenose dolphins are rarely observed north of the North Carolina-Virginia border, and their northern distribution appears to be limited by water temperatures < 9.5 ºC (Garrison *et al.* 2003; Kenney 1990). Bottlenose dolphin densities are highest during winter months along the North Carolina coast south of Cape Hatteras (Garrison *et al*. 2003; Torres *et al.* 2005). Seasonal variation in the densities of animals observed off Virginia Beach, Virginia also indicates the seasonal migration of dolphins northward during summer months and then south during winter (Barco and Swingle 1996). Four dolphins tagged during 2003 and 2004 off the coast of New Jersey in late summer moved south to North Carolina and inhabited waters near and just south of Cape Hatteras during winter months. These animals then moved north to New Jersey again during the following summer (NMFS, Southeast Fisheries Science Center, unpublished data). Similarly, dolphins tagged off Virginia Beach, Virginia during the late summer occupied the area between Cape Hatteras and Cape Lookout during winter months (NMFS 2001). There is no evidence suggesting that these animals moved farther south than Cape Lookout during winter months, and there are genetic differences between animals sampled in North Carolina and areas further south (NMFS 2001). In addition, there are no matches in long term photo-identification studies between sites in New Jersey and those south of Cape Hatteras (Urian *et al.* 1999; NMFS 2001). These studies are the basis for the definition of the Northern Migratory stock in this and previous stock assessment reports.

Satellite tag telemetry studies also provide evidence for a stock of dolphins migrating seasonally along the coast between North Carolina and northern Florida. Two dolphins were tagged during November just south of Cape Fear, North Carolina. One of these animals remained along the South Carolina and southern North Carolina coasts throughout the winter while the other migrated south to northern Florida through February. In the spring, these animals moved farther north of the tagging site to Cape Hatteras. The tags did not last beyond June, and therefore the distribution of these animals during summer months is unknown (NMFS, Southeast Fisheries Science Center, unpublished data). However, there are no available genetic data to test conclusively whether or not this migrating group represents a distinct stock. Available data do demonstrate significant genetic differences between animals sampled off southern North Carolina during summer months and groups both farther north (i.e., Northern Migratory animals) and farther south. Given the observed migration patterns, a prospective Southern Migratory stock of coastal bottlenose dolphins moving between North Carolina in the summer and along the south Atlantic coast during the winter is defined.

In addition to these two migrating coastal stocks, there is evidence for coastal resident stocks. In North Carolina, additional satellite telemetry studies and movements of tracked freeze-branded animals demonstrate that some animals occurring in coastal waters do not migrate and instead reside along the North Carolina coast or in Pamlico Sound year-round (NMFS 2001). Photo-identification studies at multiple sites in North Carolina indicate frequent exchange of animals between Beaufort, North Carolina (Cape Lookout) and Wilmington, North Carolina (Cape Fear, Urian *et al.* 1999). However, there was little exchange of animals between southern North Carolina (i.e., south of Cape Lookout) and northern North Carolina or points further north (Urian *et al.* 1999, NMFS 2001). In addition, genetic analyses of samples from northern Florida, Georgia, central South Carolina (primarily the estuaries around Charleston), and southern North Carolina using both mitochondrial DNA and nuclear microsatellite markers indicate significant genetic differences between these areas (NMFS 2001). As a result, the previously defined Southern North Carolina stock is retained in this revised stock structure. There is also evidence for genetic differences between animals occupying the northern and central Florida coast (NMFS 2001). The spatial extent of these stocks, their potential seasonal movements, and their relationships with estuarine stocks are poorly understood. However, based upon the available genetic and photo-identification data, prospective stocks of coastal residents are defined.

In summary, this stock assessment report identifies seven prospective stocks of coastal morphotype bottlenose dolphins inhabiting nearshore coastal waters along the Atlantic coast (Figure 1). This prospective stock structure differs from that described in previous stock assessment reports in that 1) the Southern Migratory stock is a new identified group, 2) the previously defined summer Northern North Carolina stock is presumed to correspond primarily to the Southern Migratory stock and is redefined to exclude estuarine residents, and 3) the seasonal management unit framework of using half-year PBR values for some stocks and designating a winter mixed North Carolina management unit has been discarded. In addition, whereas the previous stock structure included estuarine residents, and incorporated available estuarine abundance estimates into N_{min} and PBR, the revised structure does not include estuarine resident stocks. For the Central Florida, Northern Florida, Georgia, South Carolina, and Southern North Carolina stocks, the latitudinal boundaries remain the same as those in previous stock assessments and do not change seasonally (Table 1). The summertime boundaries between the Southern Migratory and Northern Migratory stocks are redefined based upon a spatial analysis described below. During winter months, the Northern Migratory stock migrates south and occupies waters along the North Carolina coast north of Cape Lookout. Available tagging and photo-identification data suggest that animals inhabiting North Carolina estuaries also move onto the coast during winter and overlap with these Northern Migratory animals. Similarly, the Southern Migratory stock overlaps with the Northern Florida, Georgia, South Carolina, and Southern North Carolina stocks during winter months. The assignment of mortality to the appropriate stocks along the North Carolina coast during winter months remains problematic. This revised structure is provisional while additional analysis of available genetic data is conducted to confirm the separations amongst coastal resident stocks and verify distinctions between coastal and estuarine stocks. Additional field sampling will be required to adequately describe the Southern Migratory stock.

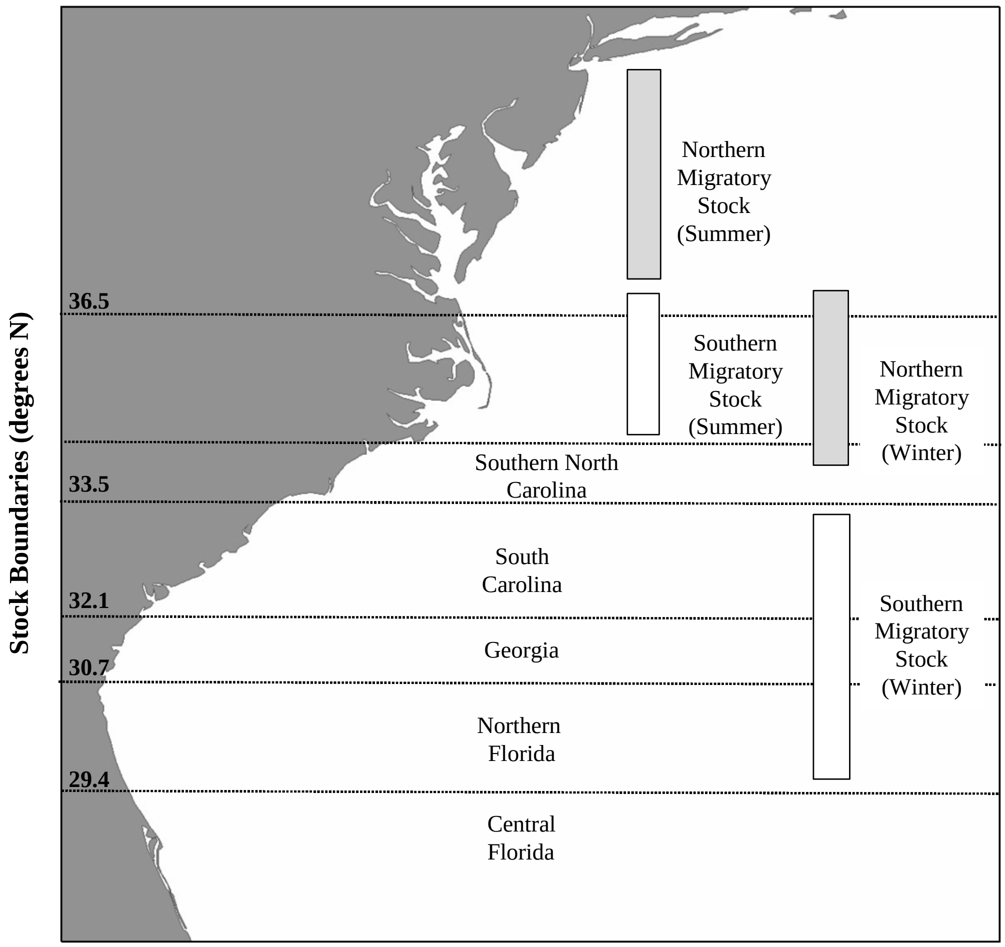

Figure 1. Seasonal distribution and spatial boundaries for prospective stocks of the coastal morphotype of bottlenose dolphin along the Atlantic coast.

POPULATION SIZE

Aerial surveys to estimate the abundance of coastal bottlenose dolphins were conducted during winter (January-February) and summer (July-August) of 2002. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40 m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20 m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. Survey effort was also stratified to optimize coverage in seasonal management units. The surveys employed two observer teams operating independently on the same aircraft to estimate visibility bias.

The winter survey included the region from the Georgia/Florida state line to the southern edge of Delaware Bay. A total of 6,411 km of trackline was completed during the survey, and 185 bottlenose dolphin groups were sighted including 2,114 individual animals. No bottlenose dolphins were sighted north of Chesapeake Bay corresponding to water temperatures < 9.5 ºC. During the summer survey, 6,734 km of trackline were completed between Sandy Hook, New Jersey and Ft. Pierce, Florida. All tracklines in the 0-20 m stratum were completed throughout the survey range while offshore lines were completed only as far south as the Georgia-Florida state line. A total of 185 bottlenose dolphin groups was sighted during summer including 2,544 individual animals.

In summer 2004, an additional aerial survey between central Florida and New Jersey was conducted. As with the 2002 surveys, effort was stratified into 0-20 m and 20-40 m strata with the majority of effort in the shallow depth stratum. The survey was conducted between 16 July and 31 August and covered 7,189 km of trackline. There was a total of 140 sightings of bottlenose dolphins including 3,093 individual animals. A winter survey was conducted between 30 January and 9 March, 2005 covering waters from the mouth of Chesapeake Bay through central Florida. The survey covered 5,457 km of trackline and observed 135 bottlenose dolphin groups accounting for 957 individual animals.

Abundance estimates for bottlenose dolphins in each stock were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The 2002 surveys included two teams of observers to derive a correction for visibility bias. The independent and joint estimates from the two survey teams were used to quantify the probability that animals available to the survey on the trackline were missed by the observer teams, or perception bias, using the direct duplicate estimator (Palka 1995). The resulting estimate of the probability of seeing animals on the trackline was applied to abundance estimates for the summer 2004 and winter 2005 surveys. Observed bottlenose dolphin groups were also partitioned between the coastal and offshore morphotypes based upon analysis of available biopsy samples (Garrison *et al.* 2003).

For the Central Florida, Northern Florida, Georgia, South Carolina, and Southern North Carolina stocks, the mean of the summer 2002 and 2004 abundance estimates provided the best estimate of abundance (Table 1). During winter months, these stocks overlap spatially with either the Southern Migratory or Northern Migratory stocks. There is apparent inter-annual variation in the abundance estimates and observed spatial distribution of bottlenose dolphins in this region that may indicate movements of animals in response to environmental variability. However, at this time there is no tag telemetry or genetic evidence supporting the presence of additional migratory stocks along the southern portion of the survey range. The survey abundance estimates for these stocks were stratified based upon the fixed boundaries shown in Figure 1.

The summer surveys are also the best for estimating the abundance for both the Northern and Southern Migratory stocks since they overlap least with other stocks during summer months. The Southern Migratory stock most likely occupies waters along the coast of North Carolina north of Cape Lookout during summer months. There is a resident population of animals within Pamlico Sound (e.g., Read *et al.* 2003), and some of these animals may also occur along the coast and overlap with the Southern Migratory group. However, for the purposes of this assessment, we are assuming that the majority of the animals in this area belong to the Southern Migratory stock.

An analysis of summer survey data from 1995, 2002, and 2004 demonstrated strong inter-annual variation in the spatial distribution of presumed Southern Migratory and Northern Migratory stock animals. Two groups of dolphins in each survey year were identified using a multivariate cluster analysis of sightings based on water temperature, depth, and latitude. One group ranged from Cape Lookout, North Carolina to just north of the Chesapeake Bay mouth, and one ranged farther north along the eastern shore of Virginia to New Jersey. The southern group (i.e., the Southern Migratory stock) was found in water temperatures between 26.5 and 28.0 °C, and the northern group (i.e., the Northern Migratory stock) occurred in cooler waters between 24.5 and 26.0 °C. The spatial distribution of these groups was strongly correlated with water temperatures and varied between years. During the summer of 2004, water temperatures were significantly cooler than those during 2002, and animals from both groups were distributed farther south and overlapped spatially. The best abundance estimate for these two groups is therefore from the summer 2002 survey when there was little overlap and an apparent separation between the two stocks at approximately 37.5°N latitude. This boundary is based upon the distribution of the two identified clusters of animals, and it will vary between years as a function of varying water temperatures. Abundance estimates from the summer 2002 survey were derived for these stocks by post-stratifying survey effort and sightings into the identified spatial range of the two clusters of animals (Table 1).

Table 1. Estimates of abundance and the associated CV, n_{min}, and PBR for each stock of WNA coastal bottlenose dolphins . All estimates are derived from summer aerial surveys conducted in 2002 and/or 2004 as noted in the table. The recovery factor (Fr) used to calculate PBR for each stock is based upon the CV of the mortality estimate based on the guidelines in Wade and Angliss (1997).

Stock	Abundance Summer 2002 (CV)	Abundance Summer 2004 (CV)	Best Estimate (CV)	Nmin	Recovery Factor (Fr)	PBR
Northern Migratory	7,489 (0.36)	NA[a]	7,489 (0.36)	5,582	0.5	56
Southern Migratory	10,341 (0.33)	NA[a]	10,341 (0.33)	7,889	0.5	79
Southern North Carolina	3,654 (1.11)	5,983 (0.43)	4,818 (0.50)	3,241	0.5	32
South Carolina	2,284 (0.27)	1,620 (0.56)	1,952 (0.28)	1,548	0.5	15
Georgia	6,234 (0.50)	5,759 (0.55)	5,996 (0.37)	4,434	0.5	44
Northern Florida	737 (0.47)	5,391 (0.27)	3,064 (0.24)	2,502	0.5	25
Central Florida	718 (0.51)	11,918 (0.27)	6,317 (0.26)	5,109	0.5	51

[a] During the summer 2004 survey, a cluster analysis indicated a high degree of spatial overlap between these two stocks, preventing a reliable abundance estimate.

Minimum Population Estimate

The minimum population size (Nmin) for each stock was calculated as the lower bound of the 60% confidence interval for a lognormally distributed mean (Wade and Angliss 1997). Minimum population sizes for each stock are shown in Table 1.

Current Population Trend

There are insufficient data to determine the population trend for these stocks.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the WNA coastal morphotype. 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 the minimum population size, one-half the maximum productivity rate, and a recovery factor (Wade and Angliss 1997). This group of prospective stocks incorporates the range of the former WNA coastal migratory stock that was defined as depleted under MMPA guidelines. At least some of these stocks are likely depleted relative to their optimum sustainable population (OSP) size due both to mortality during the 1987-1988 die-off and high incidental mortality in fisheries. Given the known population structure within the coastal morphotype bottlenose dolphins, it is appropriate to apply PBR separately to each stock so as to achieve the goals of the MMPA (Table 1; Wade and Angliss 1997).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The primary known source of fishery mortality is the mid-Atlantic coastal gillnet fishery, which affects the Northern Migratory, Southern Migratory, and Southern North Carolina stocks. The five-year average mortality due to this fishery is currently unknown. In addition, an estimated 1 (CV = 0.36) mortalities occurred annually in the shark gillnet fisheries off the coast of Florida during 2002-2006, affecting the Central Florida management unit. Only limited observer data are available for other fisheries that may interact with WNA coastal bottlenose dolphins. Therefore, the total average annual mortality estimate is a lower bound of the actual annual human-caused mortality for each stock. Detailed fishery information is presented in Appendix III.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeast 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 Magnuson Fisheries Conservation and Management Act (MFCMA).

Stranding data for 1993-1997 document interactions between WNA coastal bottlenose dolphins and pound nets in Virginia. Two bottlenose dolphin carcasses were found entangled in the leads of pound nets in Virginia during 1993-1997, an average of 0.4 bottlenose dolphin mortalities per year. A third record of an entangled bottlenose dolphin in Virginia in 1997 may have been associated with this fishery. This entanglement involved a bottlenose dolphin carcass found near a pound net with twisted line marks consistent with the twine in the nearby pound net lead rather than with monofilament gillnet gear.

One bottlenose dolphin was recovered dead from a shrimp trawl in Georgia in 1995 (Southeast Region Marine Mammal Stranding Network, unpublished data), and another was taken in 1996 near the mouth of Winyah Bay, South Carolina, during a research survey. In August 2002 in Beaufort County, South Carolina, a fisherman self-reported a dolphin entanglement in a commercial shrimp trawl. No other bottlenose dolphin mortality or serious injury has been reported to NMFS. There has been very little systematic observer coverage of this fishery during the last decade.

The Atlantic menhaden purse seine fishery historically reported an annual incidental take of 1 to 5 bottlenose dolphins (NMFS 1991, pp. 5-73). However, no observer data are available, and this information has not been updated for some time.

Mid-Atlantic Gillnet

This fishery has the highest documented level of mortality of WNA coastal morphotype bottlenose dolphins, and the North Carolina sink gillnet fishery is its largest component in terms of fishing effort and observed takes. Of 12 observed mortalities between 1995 and 2000, 5 occurred in sets targeting spiny or smooth dogfish, 1 was in a set targeting “shark” species, 2 occurred in striped bass sets, 2 occurred in Spanish mackerel sets, and the remainder were in sets targeting kingfish, weakfish, or finfish generically (Rossman and Palka 2001). Only two bottlenose dolphin mortalities were observed in 2001-2002, and both occurred in the winter just north of the North Carolina/Virginia border. Based on the prospective stock structure described here, these mortalities are most likely from the Northern Migratory stock. Four additional mortalities were observed during summer along the North Carolina coast near Cape Hatteras: one in 2003, one in 2004, and two in 2006. These mortalities are most likely to have impacted the prospective Southern Migratory stock. The methodology for estimating total mortality is currently being revised to account for the prospective stock structure and improved understanding of the seasonal spatial distribution of these stocks. In addition, the Bottlenose Dolphin Take Reduction Plan was implemented in May 2006, and there has been insufficient time to collect data to support mortality analyses and assess the effectiveness of the plan. Therefore, it is currently not possible to estimate total mortality from the gillnet fisheries for these prospective stocks. The mortality estimates will be updated in the 2009 stock assessment report.

Table 2. Summary of the 2002-2006 incidental mortality of bottlenose dolphins (*Tursiops truncatus*) by management unit in the commercial mid-Atlantic coastal gillnet fisheries. Data include the years sampled (Years), the number of vessels active within the fishery (Vessels), type of data used (Data Type), observer coverage (Observer Coverage), mortalities recorded by on-board observers (Observed Mortality), estimated annual mortality (Estimated Mortality), estimated CV of the annual mortality (Estimated CVs), and mean annual mortality (CV in parentheses).

Stock	Years	Vessels	Data Type[a]	Observer Coverage [b]	Observed Serious Injury	Observed Mortality	Estimated Mortality[d]	Estimated CVs [c]	Mean Annual Mortality
Northern Migratory	2002-2006	unk	Obs. Data, NER Dealer Data	.01, .03, .03, .05, .06	0, 0, 0, 0, 0	2, 0, 0, 0, 0	unk[e]	unk[e]	unk[e]
Southern Migratory	2002-2006	unk	Obs. Data, NCDMF Dealer Data	.0, .01, .02, .02, .03	0, 0, 0, 0, 0	0, 1, 0, 1, 2	unk[e]	unk[e]	unk[e]
Southern North Carolina	2002-2006	unk	Obs. Data, NCDMF Dealer Data	0,.01, .03, .01, .04	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk[e]	unk[e]	unk[e]
Total	2002-2006								unk[e]

NA=Not applicable, unk = unknown or unobserved

a Observer data (Obs. data) are used to measure bycatch rates; the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. The NEFSC collects weighout landings data that are used as a measure of total effort for the sink gillnet fisheries.

b The observer coverage for the mid-Atlantic coastal sink gillnet fishery is measured as a proportion of the tons of fish landed.

c The annual estimates of mortality are computed by summing mortality estimates over six strata for each management unit. Stratified bycatch rates are estimated by a generalized linear model (Palka and Rossman 2001). An aggregate weighted CV is then calculated by weighting the stratified bycatch rates and variances by the proportion of observed metric tons sampled within each stratum. The CV does not account for variability that may exist in the unit of total landings (mt) from each year that are used to expand the bycatch rate.

d From November 2000 through April 2006 only 4 coastal bottlenose dolphins mortalities have been observed in the coastal habitat ranging from New Jersey to southern North Carolina. As a result, the data were too sparse to apply to the previously defined model used to estimate bycatch rates during the 1996 - 2000 time period (Palka and Rossman 2001). A traditional stratified ratio-estimator was used to estimate bycatch mortality for the seasonal management units from winter 2001 through the winter of 2006. A NEFSC Laboratory Reference Document documenting the methods and results is expected to be available for distribution in January 2008.

e It is currently not possible to estimate total mortality due to the revisions to the stock structure and implementation of the bottlenose dolphin take reduction plan. Mortality estimates will be updated in the 2009 SAR.

South Atlantic Shark Drift Gillnet

Observed takes of bottlenose dolphins occurred primarily during winter months when the fishery operates in waters off southern Florida. Fishery observer coverage outside of this time and area has increased significantly in the last several years, and there was one observed mortality during summer months in fishing operations off Cape Canaveral, Florida. There have been no observed interactions with bottlenose dolphins since 2003 (Carlson and Betha 2006; Garrison 2007). All observed fishery takes are restricted to the Central Florida management unit of coastal bottlenose dolphin. Total bycatch mortality has been estimated for 2002-2006 following methods described in (Garrison 2007, Table 3).

Table 3. Summary of the 2002-2006 incidental mortality of bottlenose dolphins (*Tursiops truncatus*) by stock in the shark gillnet fishery in federal waters off the coast of Florida. Data include years sampled (Years), number of vessels active within the fishery (Vessels), type of data used (Data Type), annual observer coverage (Observer Coverage), mortalities recorded by on-board observers (Observed Mortality), estimated annual mortality (Estimated Mortality), estimated CV of the annual mortality (Estimated CVs), and mean annual mortality (CV in parentheses).

Seasonal Management Unit	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Serious Injury	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northern Florida	2002-2006	6	Obs. Data, SEFSC FVL	0.46, 0.73, 0.22, 0, 0	0, 0, 0, NA, NA	0, 0,0, NA, NA	0, 0, 0, 0, 0	NA	0
Central Florida	2002-2006	6	Obs. Data, SEFSC FVL	1[c], .34, .43, 1[c], 1[c]	0, 0, 0, 0,0	1, 2 ,0, 0, 0	1[c], 2 , 1, 0[c], 0[c]	0, .64, .64, 0, 0	0.8 (.36)

unk = unknown, NA = cannot be calculated

a Observer data are used to estimate bycatch rates. The SEFSC Fishing Vessel Logbook (FVL) is used to estimate effort as total number of reported sets per bottlenose dolphin stock.

b Observer coverage targets 100% of sets during winter months in the Central Florida stock area. There is apparent under-reporting of effort as the number of observed drift net sets routinely exceeds the number of reported drift sets for this fishery. Coverage of the drift net fishery is much lower outside of these months and in the Northern Florida stock area. In addition, the total amount of fishing effort using drift nets targeting sharks is unknown as fishermen do not report the type of gillnet set and boats fish using drift, strike, and sink nets during the same seasons (Garrison 2007)

c The number of observed drift sets exceeded the number of reported sets, therefore the observed mortality is presumed to be the total mortality.

Beach Haul Seine

Two coastal bottlenose dolphin takes were observed in the mid-Atlantic beach haul seine fishery: 1 in May 1998 and 1 in December 2000.

Crab Pots

Between 1994 and 1998, 22 bottlenose dolphin carcasses (4.4 dolphins per year on average) recovered by the Stranding Network between North Carolina and Florida's Atlantic coast displayed evidence of possible interaction with a trap/pot fishery (i.e., rope and/or pots attached, or rope marks). Additionally, at least 5 dolphins were reported to be released alive (condition unknown) from blue crab traps/pots during this time period. During 2003, 2 bottlenose dolphins were observed entangled in crab pot lines in South Carolina, including 1 confirmed mortality, and 2 bottlenose dolphins were disentangled alive from crab pots in Virginia. In 2004, the SER stranding network reported observing 3 bottlenose dolphins (including one mortality) entangled in crab pot lines in Florida, one in Georgia, and three in South Carolina. In 2005, one entanglement was observed in Florida, one in Georgia, and one in Virginia. With the exception of the mortality in Florida during 2004, all animals were released from entangling gear and were not described to be seriously injured (SER Stranding Network). Three bottlenose dolphins were observed entangled in crab pot gear during 2006. Two occurred in South Carolina and were released alive, while one mortality occurred near Cape Canaveral, Florida. A review of stranding network data from South Carolina between 1992 and 2003 indicated that 24% of known bottlenose dolphin entanglements could be confirmed as involving crab pots, and an additional 19% of known entanglements were probable interactions with crab pots (Burdett and McFee 2004). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab pots. However, it is clear that this interaction is a common occurrence and does result in mortalities of coastal morphotype bottlenose dolphins.

In addition to blue crab pots, there have been four documented interactions with pot fisheries in southern Florida. These include two interactions (one in 2003, one in 2006) with stone crab pots near Miami, FL and two interactions (one in 2003 and one in 2006) with spiny lobster traps also off Miami and the Florida Keys. One of these interactions (with a stone crab pot) resulted in a mortality.

Virginia Pound Nets

Stranding data for 2002-2006 indicate interactions between coastal bottlenose dolphins and pound nets in Virginia. Twenty dolphins were removed dead from pound nets and 5 were disentangled and released alive. This includes three mortalities observed during 2006. Additionally, 17 animals stranded with twisted twine line marks consistent with nearby pound net leaders (SER Stranding Network)

Other Mortality

There have been occasional mortalities of bottlenose dolphins during research activities including both directed live capture studies and fisheries surveys. In March 2002, a dolphin was entangled in the lazy line of a turtle relocation trawl off Bogue Banks, North Carolina. In August 2002, a dolphin died during a fisheries research project using a trammel net in South Carolina (NMFS Protected Resources Division). Similarly, in March and November 2004, three dolphin mortalities occurred, including a mother-calf pair, during a fisheries research project using a trammel net in Georgia (SER Stranding Network). During 2004, one female bottlenose dolphin died during a health assessment capture study in Charleston, South Carolina (NMFS Protected Resources Division). In July and October 2006, two mortalities occurred during a fisheries research project using trawl gear in South Carolina and North Carolina (SER Stranding Network). Two bottlenose dolphins tagged with an experimental transmitter package deployed during a NMFS research program in North Carolina died within several weeks of tagging during spring 2006 (NMFS Protected Resources Division). Finally, two bottlenose dolphins were killed in research trawls conducted by the South Carolina Department of Natural resources during 2006: one in July near Beaufort County, South Carolina and one in October off Brunswick City, North Carolina. All mortalities from known sources including commercial fisheries and research related mortalities for each provisional stock are summarized in Table 4.

The nearshore and estuarine habitats occupied by the coastal morphotype are adjacent to areas of high human population and some are highly industrialized. The blubber of stranded dolphins examined during the 1987-88 mortality event contained very high concentrations of organic pollutants (Kuehl *et al*. 1991). More recent studies have examined persistent organic pollutant concentrations in bottlenose dolphin tissues from several estuaries along the Atlantic coast and have likewise found evidence of high blubber concentrations particularly near Charleston, South Carolina and Beaufort, North Carolina (Hansen *et al.* 2004). The concentrations found in male dolphins from both of these sites exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on estuarine dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

Table 4. Total estimated mortalities from known sources for each prospective stock. The annual mean of estimated mortalities from commercial fisheries with observer programs (mid-Atlantic gillnet [Table 2] and shark gillnet [Table 3]) are shown. For other mortalities with known sources (Crab Pot, Virginia Pound Net, and Research Takes) the mortalities are direct observations, and hence underestimate the true total mortality from these sources. Dashes indicate that the fishery or mortality source does not occur within the region of the effected stock.

Stock	Years	Mid-Atlantic Gillnet[a]	Shark Gillnet	Va. Pound Net	Crab Pot	Marine Mammal Research[b]	Other Research[b]	Annual Totals	5-year Annual Average
Northern Migratory	2002-2006	unk	-	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk	unk
Southern Migratory		unk	-	1, 3, 5, 4, 3	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk	unk
Southern North Carolina		unk	-	-	0, 0, 0, 0, 0	0, 0, 0, 0, 2	1, 0, 0, 0, 1	unk	unk
South Carolina		-	-	-	0, 1, 0, 0, 0	0, 0, 1, 0, 0	1, 0, 0, 0, 1	1, 1, 1, 0, 1	0.8
Georgia		-	0	-	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 3, 0, 0	0, 0, 3, 0, 0	0.6
Northern Florida		-	0	-	0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0
Central Florida		-	1, 2, 0, 1, 0	-	0, 0, 0, 0, 1	0, 0, 0, 0, 0	0, 0, 0, 0, 0	1, 2, 1, 0, 1	0.8

[a] As noted in Table 2, the Mid-Atlantic gillnet mortality cannot be estimated at this time due to changes in the stock structure and the implementation of the BDTRP. Mortality estimates will be updated in the 2009 SAR.

[b] Marine mammal research includes both live capture and tagging studies permitted under an MMPA research permit. Other research includes fisheries research trammel netting and trawls and turtle relocation trawling operations.

Strandings

From 2002 to 2006, 1,570 bottlenose dolphins stranded along the Atlantic coast from New York to Florida (Table 5, Northeast Regional Marine Mammal Stranding Network, Southeast Regional Marine Mammal Stranding Network). Of these, it was possible to determine whether or not a human interaction had occurred for 715 (46%). For the remainder, it was not possible to make that determination. Of those cases where an evaluation was possible, 32% of the carcasses had evidence of fisheries interaction; however, it should be noted that this was not necessarily the cause of death. The highest numbers of stranded animals with evidence of fisheries interactions were observed in Virginia, North Carolina, and Florida. Stranded carcasses are not routinely identified to either the offshore or coastal morphotype of bottlenose dolphin, and it is therefore possible that some of the reported strandings were of the offshore form.

Table 5. Summary of bottlenose dolphins stranded along the Atlantic Coast . Total Stranded is separated into cases with with line or nets marks (Fishery Interaction), other indications of human interactions, no apparent human interaction, or where a determination could not be made (CBD).

	2002	2003	2004	2005	2006
New York – Total Stranded	**1**	**2**	**0**	**0**	**6**
--Fishery Interaction	0	0	0	0	0
--Other Human Interaction	0	0	0	0	0
--No Human Interaction	0	1	0	0	3
--CBD	1	1	0	0	3
New Jersey – Total Stranded	**11**	**7**	**15**	**13**	**14**
--Fishery Interaction	1	1	1	0	1
--Other Human Interaction	1	0	1	0	2
--No Human Interaction	4	5	11	7	9
--CBD	5	1	2	6	2
Delaware – Total Stranded	**13**	**18**	**16**	**9**	**10**
--Fishery Interaction	1	1	1	1	1
--Other Human Interaction	0	0	0	0	1
--No Human Interaction	8	13	11	1	0
--CBD	4	4	4	7	8
Maryland – Total Stranded	**5**	**10**	**10**	**4**	**11**
--Fishery Interaction	0	1	1	1	2
--Other Human Interaction	0	0	0	0	0
--No Human Interaction	2	8	6	0	3
--CBD	3	1	3	3	6
Virginia – Total Stranded	**67**	**60**	**75**	**60**	**63**
--Fishery Interaction	15	25	22	13	17
--Other Human Interaction	6	0	2	0	0
--No Human Interaction	7	12	13	20	4
--CBD	39	23	38	27	42
North Carolina – Total Stranded	**92**	**69**	**89**	**78**	**66**
--Fishery Interaction	13	11	15	9	6
--Other Human Interaction	2	0	1	3	1
--No Human Interaction	15	16	22	14	15
--CBD	62	42	51	52	44
South Carolina – Total Stranded	**28**	**35**	**46**	**38**	**39**
--Fishery Interaction	4	3	3	5	5
--Other Human Interaction	0	0	3	0	1
--No Human Interaction	13	17	22	17	12
--CBD	11	15	18	16	21
Georgia – Total Stranded	**11**	**17**	**27**	**14**	**23**
--Fishery Interaction	0	0	3	2	2
--Other Human Interaction	0	0	1	0	0
--No Human Interaction	0	2	9	2	4
--CBD	11	15	14	10	17
Florida – Total Stranded	**82**	**74**	**81**	**68**	**93**
--Fishery Interaction	8	11	7	6	8
--Other Human Interaction	2	0	2	2	6
--No Human Interaction	50	21	27	14	11
--CBD	22	42	45	46	68
TOTAL	**310**	**292**	**359**	**284**	**325**

STATUS OF STOCKS

The coastal migratory stock was designated as depleted under the MMPA. From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the WNA, and the entire stock was listed as depleted. This stock structure was revised in 2002 to recognize both multiple stocks and seasonal management units. The prospective stocks described here replace these management units. This prospective stock structure continues to be evaluated using available data and will be finalized when these analyses are complete. It should be noted that the impacts of entanglements with crab pots in Georgia and South Carolina and the total mortality associated with pound nets in Virginia are unknown. Likewise, the total mortality in the mid-Atlantic gillnet fishery is currently unknown pending collection of additional data and analysis. Thus, evaluation of mortality for these stocks will not be available until the next stock assessment report. The total U.S. fishery-related mortality and serious injury for the Northern Migratory and Southern Migratory stocks likely is not less than 10% of the calculated PBR, and thus cannot be considered to be insignificant and approaching zero mortality and serious injury rate. Since one or more of the stocks may be depleted, all stocks retain the depleted designation. The species is not listed as threatened or endangered under the Endangered Species Act, but these are strategic stocks due to the depleted listing under the MMPA.

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HARBOR PORPOISE (*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, b), 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 1980~~'~~s (Smithsonian strandings database) and one ~~during~~ in 2003 (NE Regional Office/NMFS strandings and entanglement database).

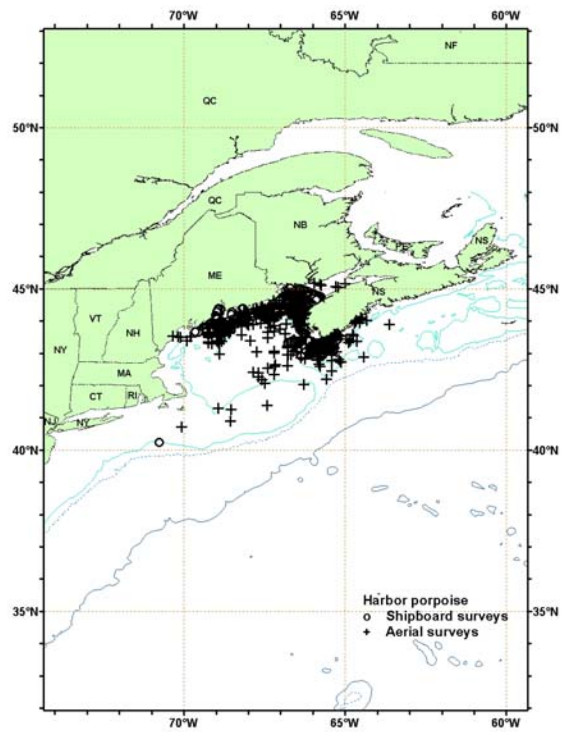

Figure 1. *Distribution of harbor porpoises from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, and 2006. Isobaths are the 100m, 1000m, and 4000m depth contours.*

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. Recent analyses involving mtDNA (Wang *et al.* 1996; Rosel *et al.* 1999a, 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 (Rosel *et al.* 1999a; Palka *et al.* 1996) and CHLORs, DDTs, PCBs and CHBs (Westgate and Tolley 1999). Analyses of stranded animals from the mid-Atlantic states suggest that this aggregation of harbor porpoises consists of animals from more than just the Gulf of Maine/Bay of Fundy stock (Rosel *et al.* 1999a). However, the majority of the samples used in the Rosel *et al.* (1999a) study were from stranded juvenile animals. Further work is needed to examine adult animals from this region. 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. 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, seven line-transect sighting surveys were conducted during the summers of 1991, 1992, 1995, 1999, 2002, 2004, and 2006. 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 is the most current, and this survey covered the largest portion of the harbor porpoise range.

Earlier abundance estimates

Earlier abundance calculations include estimates of 37,500 harbor porpoises in 1991 (CV=0.29, 95% confidence interval (CI)=26,700-86,400) (Palka 1995a), 67,500 harbor porpoises in 1992 (CV=0.23, 95% CI=32,900-104,600), and 74,000 harbor porpoises in 1995 (CV=0.20, 95% CI=40,900-109,100) (Palka 1996). The inverse variance weighted-average abundance estimate (Smith *et al.* 1993) of the 1991 to 1995 estimates was 54,300 harbor porpoises (CV=0.14, 95% CI=41,300-71,400). Possible reasons for inter-annual differences in abundance and distribution include experimental error, inter-annual changes in water temperature and availability of primary prey species (Palka 1995b), and movement among population units (e.g., between the Gulf of Maine and Gulf of St. Lawrence).

Kingsley and Reeves (1998) estimated there were 12,100 (CV=0.26) harbor porpoises in the entire Gulf of St. Lawrence during 1995, and 21,700 (CV=0.38) in the northern Gulf of St. Lawrence during 1996. These estimates are presumed to be of the Gulf of St. Lawrence stock of harbor porpoises. The highest densities were north of Anticosti Island, with lower densities in the central and southern Gulf. During the 1995 survey, 8,427km of track lines were flown in an area of 221,949 km^2 during August and September. During the 1996 survey, 3,993km of track lines were flown in an area of 94,665 km^2 during July and August. Data were analyzed using Quenouille's jackknife bias reduction procedure on line transect methods that modeled the left truncated sighting curve. These estimates were not corrected for visibility biases such as *g(0)*.

An abundance estimate of 89,700 (CV=0.22, 95% CI=53,400-150,900) harbor porpoises was obtained from a July to August 1999 sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence (Table 1; Palka 2000). Total trackline length was 8,212 km. One of the reasons the 1999 estimate is larger than previous estimates is that, for the first time, the upper Bay of Fundy and northern Georges Bank were surveyed and harbor porpoises were seen in both areas. This indicates the harbor porpoise summer habitat is larger than previously thought (Palka 2000). 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 89,700 (CV=0.22, 95% CI=53,400-150,900) harbor porpoises was obtained from a July to August 1999 sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence (Table 1; Palka 2000). Total track line length was 8,212 km. One of the reasons the 1999 estimate is larger than previous estimates is that, for the first time, the upper Bay of Fundy and northern Georges Bank were surveyed and harbor porpoises were seen in both areas. This indicates the harbor porpoise summer habitat is larger than previously thought (Palka 2000).~~

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 data of 2002, 2004 and 2006 aerial survey data.

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 100m 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~~ 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~~ 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 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.).

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
~~Jul-Aug 1999~~	~~S. Gulf of Maine to upper Bay of Fundy and to Gulf of St. Lawerence~~	~~89,700~~	~~0.22~~
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
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawerence	89,054	0.47

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

Although current population growth rates of Gulf of Maine/Bay of Fundy harbor porpoises have not been estimated due to lack of data, 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. Consequently, for the purposes of this assessment, the maximum net productivity rate was assumed to be 4%, consistent with values used for other cetaceans for which direct observations of maximum rate of increase are not available, and following a recommendation from the Atlantic Scientific Review Group. The 4% 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 60,970. 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 Gulf of Maine/Bay of Fundy harbor porpoise is 610.

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 4).

The total annual estimated average human-caused mortality is 874~~734~~ (CV=0.13~~6~~) harbor porpoises per year. This is derived from four components: 866~~652~~ harbor porpoise per year (CV=0.13~~6~~) from U.S. fisheries using observer and MMAP data, 2~~77~~ per year (unknown CV) from Canadian herring weir fisheries using observer data, and 5.7~~5.0~~ per year from ~~U.S.~~ 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, Northeast bottom trawl 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 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, 1987).

In 1990, an observer program was started by NMFS to investigate marine mammal takes in the Northeast sink gillnet fishery (Appendix III). There have been ~~552~~ 578 harbor porpoise mortalities related to this fishery observed between 1990 and ~~2005~~ 2006~~and one was released alive and uninjured~~. 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-~~2005~~ 2006 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) (Bravington and Bisack 1996; CUD 1994), 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, ~~and~~ 630 (0.23) in 2005, and 514 in 2006. ~~In November 2001, there were two takes reported through the Marine Mammal Authorization Program (MMAP) that were taken in one sink gillnet haul located near Jefferys Ledge. These two takes were then added to the 2 observed takes and 51 estimated total take that was derived from the observer data because the MMAP takes were in a time and area not included in any of the above observer-based bycatch estimates. This then results in 4 observed takes and 53 (0.97) total takes in 2001 from this fishery (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, harbor porpoise takes in pingered nets were less than in non-pingered nets. ~~Two preliminary experiments, using acoustic alarms (pingers) attached to gillnets, were conducted in the Gulf of Maine during 1992 and 1993 and took 10 and 33 harbor porpoises, respectively. During fall 1994, another controlled scientific experiment was conducted in the southern Gulf of Maine, where 25 harbor porpoises were taken in 423 strings with non-active pingers (controls) and 2 harbor porpoises were taken in 421 strings with active pingers (Kraus *et al*. 1997). In addition, 17 other harbor porpoises were taken in nets that did not follow the experimental protocol (Table 2). After 1994, experimental fisheries were conducted where all nets in a designated area were required to use pingers and only a sample of the nets was observed. During November-December 1995, an experimental fishery was conducted in the southern Gulf of Maine (Jeffreys Ledge) region, where no harbor porpoises were observed taken in 225 pingered nets. During 1995, all takes from pingered nets were added directly to the estimated total bycatch for that year. During April 1996, 3 other experimental fisheries occurred. In the Jeffreys Ledge area, in 88 observed hauls using pingered nets, 9 harbor porpoises were taken. In the Massachusetts Bay region, in 171 observed hauls using pingered nets, 2 harbor porpoises were taken. And, in a region just south of Cape Cod, in 53 observed hauls using pingered nets, no harbor porpoises were taken. During 1997, experimental fisheries were allowed in the mid-coast region during March 25 to April 25 and November 1 to December 31. During the 1997 spring experimental fishery, 180 hauls were observed with active pingers and 220 hauls were controls (silent). All observed harbor porpoise takes were in silent nets: 8 in nets with control (silent) pingers and 3 in nets without pingers. Thus, there was a statistical difference between the catch rate in nets with pingers and silent nets (Kraus and Brault 1997). During the 1997 fall experimental fishery, out of 125 observed hauls using pingered nets no harbor porpoises were taken.~~

~~From 95 stomachs of harbor porpoises collected in groundfish gillnets in the Gulf of Maine between September and December 1989-1994, Atlantic herring (*Clupea harengus*) was the most important prey. Pearlsides (*Maurolicus weitzmani*), silver hake (*Merluccius bilinearis*) and red and white hake (*Urophycis* spp.) were the next most common prey species (Gannon *et al*. 1998).~~

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 ~~2001~~ 2002 to ~~2005~~ 2006 was ~~475~~ 567 (0.~~16~~14) (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 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). After 1998, a separate bycatch estimate was made for the drift gillnet and set gillnet sub-fisheries. The number presented here is the sum of these two sub-fisheries. 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, ~~and~~ 470 (0.51) in 2005, and 511 (0.32) in 2006. During 2002, the overall observer coverage was lower than usual, 1%, where 65% of that coverage was off ~~of~~ Virginia, and most of the rest of the area was not sampled at all. Thus, due to this non-representative and low observer coverage, a bycatch estimate for harbor porpoises cannot be confidently estimated. 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 ~~2001~~ 2002 to ~~2005~~ 2006 was

~~177~~ 299 (0.~~40~~27), which is the 4-year average estimate from ~~2001,~~ 2003, 2004, ~~and~~ 2005, and 2006.

~~**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 and, 174, and 73 stranded harbor porpoises on U.S. beaches during 1999 to 20052006, 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 three-year average harbor porpoise mortality and serious injury in this unknown fishery category from 2001 2002 to 2004 is 5.05.73.4 (CV is unknown).~~

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. Eight~~Seven~~ harbor porpoise mortalities were observed in the North~~-Atlantic~~east bottom trawl fishery between 1989 and 200~~5~~6. The first take occurred in February 1992 east of Barnegat Inlet, New Jersey at the continental shelf break. The animal was clearly dead prior to being taken by the trawl, because it was severely decomposed and the tow duration of 3.3 hours was insufficient to allow extensive decomposition. The second take occurred in January 2001 off New Hampshire in a haul trawling for flounder. This animal was clearly dead prior to being taken by the trawl, because it was severely decomposed (the skull broke off while the net was emptying) and the tow duration was 3.1 hours. This take was observed in the same time and area stratum that had documented gillnet takes. One fresh dead take was observed in the Northeast bottom trawl fishery in 2003, ~~and~~ 4 in 2005, and 1 in 2006. Estimates have not been generated for this fishery.

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, and 73 stranded harbor porpoises on U.S. beaches during 1999 to 2006, 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 three-year average harbor porpoise mortality and serious injury in this unknown fishery category from 2002 to 2004 is 5.7 (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 1980's, Canadian 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 ~~20-31~~ and 16-31 August ~~16-31~~ due to groundfish quotas. From the 107 monitored trips, the bycatch in 1996 was estimated to be 20 harbor porpoises (Trippel *et al.* 1999; DFO 1998). 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 ~~18-31~~ and 16-31 August ~~16-31~~, due to groundfish quotas. In addition a time-area closure to reduce porpoise bycatch in the Swallowtail area occurred during 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 Shepard 2001). 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. Thus, it is not known what the bycatch for these years is. The ~~average~~ estimated harbor porpoise mortality in the Canadian groundfish sink gillnet fishery during 2001 was 73 ~~(Table 2)~~. An estimate of variance is not possible.

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 1980's 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 1994). In 1993, after a cooperative program between fishermen and Canadian biologists was initiated, over 100 harbor porpoises were released alive (Read 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 (~~and~~ 50) in 1992, 33 (~~and~~ 113) in 1993, and 13 (~~and~~ 43) in 1994 (Neimanis *et al.* 1995). Since that time, an additional 623 harbor porpoises have been documented in Canadian herring weirs, of which 637 were released or escaped, 36 died, and 9 had an unknown status. Mortalities (and releases~~-~~, ~~and~~ unknowns) were 5 (~~and~~ 60, 0) in 1995; 2 (~~and~~ 4, 0) in 1996; 2 (~~and~~ 24, 0) in 1997; 2 (~~and~~ 26, 0) in 1998; 3 (~~and~~ 89, 0) in 1999; 0 (~~and~~ 13, 0) in 2000 (A. Read, pers. comm), 14 (~~and~~ 296, 0) in 2001, 3 (~~and~~ 46 ~~and~~, 4) in 2002, 1 (~~and~~ 26 ~~and~~, 3) in 2003, 4 (~~and~~ 53 ~~and~~, 2) in 2004; 0 (~~and~~ 19, ~~and~~ 5) in 2005; and 2 (~~and~~ 14 ~~and~~, 0) in 2006 (Neimanis *et al.* 2004; H. Koopman and A. Westgate, pers. comm.).

~~Clinical hematology values were obtained from 29 harbor porpoises released from Bay of Fundy herring weirs (Koopman *et al.* 1999). These data represent a baseline for free-ranging harbor porpoises that can be used as a reference for long-term monitoring of the health of this population, a mandate by the MMPA. Blood for both hematology and serum chemistry, including stress and reproductive hormones, is currently being collected; with 57 samples from 2001, 15 from 2002, 7 from 2003, 24 from 2004, 3 from 2005, and 5 from 2006 (A. Westgate and H. Koopman, pers. comm).~~

Average estimated harbor porpoise mortality in the Canadian herring weir fishery during 2002~~1~~-2006~~4~~ was 2.0~~5.5~~ (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 811 in 2001, 1671 in 2002, and 2228 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.* in press).

Table 2. From observer program data, summary of the incidental mortality of harbor porpoise (*Phocoena phocoena*) 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	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
U.S.								
Northeast Sink Gillnet	~~01~~02-~~05~~06	unk	Obs. Data, Weighout, Trip Logbook	~~.04,~~ .02 .03, .06, .07, .04	~~4[c,f],~~ 10[c], 12[c], 27[c], 51[c], 26	~~53[c,f],~~ 444[c], 592, 654[c], 630[c], 514	~~.97,~~ .37, .33, .36, .23, .31	~~475~~567 (0.~~16~~14)
Mid-Atlantic Gillnet	~~01~~02-~~05~~06	unk	Obs. Data Weighout	~~.02,~~ .01, .01, .02, .03, .04	~~1,~~unk[g], 1, 2, 15, 20	~~26,~~ unk[g], 76, 137, 470, 511	~~.95,~~ unk[g], 1.13, .91, .51, .32	~~177[g]~~299[g] (0.~~40~~27)
Northeast bottom trawl	~~01~~02-~~05~~06	unk	Obs. Data Weighout	~~.004, .021, .028~~ ~~.045, unk~~.03, .04, .05, .12, .06	~~0,~~0,1,0,4,1	~~0,~~0,unk[i],0,unk[i], unk	~~0,~~ 0, unk, 0, unk, 0	unk[i]
U.S. TOTAL	2002~~1~~-2006~~5~~							~~652~~866 (0.~~16~~13)
CANADA								
Groundfish Sink Gillnet	0~~1~~2-06~~5~~	unk	Can. Trips	~~56,~~ 0[h],0[h], 0[h], 0[h],0[h]	unk[h], ~~39,~~ unk[h], unk[h], unk[h] unk[h]	unk[h], ~~73,~~ unk[h], unk[h], unk[h] unk[h]	unk	~~73~~ ~~(~~unk~~)~~
Herring Weir	0~~1~~2-06~~5~~	1998=255 licenses[d] 2002=22[e]	Coop. Data	unk	~~14,~~ 3, 1, 4, 0, 2	~~14,~~ 3, 1, 4, 0, 2	NA	2.0~~4.4~~ (unk)
CANADIAN TOTAL	200~~0~~2-2006~~4~~							2~~77~~ (unk)
GRAND TOTAL								868~~729~~ (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. The observer coverages for the U.S. and Canadian sink gillnet fisheries are ratios based on trips, and for the mid-Atlantic coastal gillnet fishery, the unit of effort is tons of fish landed.

c. During ~~2001~~2002-~~2005~~2006, 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, ~~and~~ 12, and 2 observed harbor porpoise takes on pinger trips from 1992 to ~~2005~~2006, respectively, that were included in the observed mortality column. In addition, there were 9, 0, 2, 1,1, 4, 0, 1, 7, 21, ~~and~~ 33, and 24 observed harbor porpoise takes in 1995 to ~~2004~~2006, 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.

f. During 2001 in the U.S. Northeast sink gillnet fishery, there were 2 takes observed in the NEFSC observer program, this resulted in an estimate of 51 total bycaught harbor porpoises. In November 2001, there were two takes reported through the Marine Mammal Authorization Program that were from one sink gillnet haul that was located near Jeffery's Ledge. These two takes were then added to the 2 observed takes and 51 estimated total take derived from the observer data, resulting in 4 observed takes and 53 total takes for the fishery during 2001.

g. Sixty-five percent of sampling by the NEFSC fisheries observer program was concentrated in one area off the coast of Virginia. Coverage in other areas of the mid-Atlantic was <1%. Because of the low level of sampling that was not distributed proportionally throughout the mid-Atlantic region, the observed mortality is considered unknown in 2002. The four-year average (~~2001 and~~ 2003-~~2005~~2006) estimated mortality was applied as the best representative estimate.

h. The Canadian gillnet fishery was not observed during 2002 and afterwards, but the fishery is still~~was~~ active; thus, the bycatch estimate is unknown. ~~The average bycatch for this fishery is from the two preceding years, 2000 to 2001.~~

i. Estimates of bycatch mortality attributed to the Northeast bottom trawl fishery have not been generated.

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

Fishery	Years	Vessels	Data Type [a]	Assigned Mortality	Mean Annual Mortality
Unknown gillnet fishery	~~01~~02-~~05~~06	NA	Entanglement & Strandings	~~3,~~ 2, 9, 6, unk[b], unk[b]	~~5.0~~5.7~~3.4~~
TOTAL					~~5.0~~5.7~~3.4~~

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 an average from the years 2002-2004.

Other Mortality

U.S.

There is evidence that harbor porpoises were harvested by natives in Maine and Canada before the 1960's, and the meat was used for human consumption, oil, and fish bait (NEFSC 1992). The extent of these past harvests is unknown, though it is believed to have been small. Up until the early 1980's, 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 1993, 73 harbor porpoises were reported stranded on beaches from Maine to North Carolina (Smithsonian Marine Mammal Database). Sixty-three of those harbor porpoises were reported stranded in~~

the U.S. mid-Atlantic region from New York to North Carolina between February and May. Many of the mid-Atlantic carcasses recovered in this area during this time period had cuts and body damage suggestive of net marking (Haley and Read 1993). Five out of 8 carcasses and 15 heads from the strandings that were examined showed signs of human interactions (net markings on skin and missing flippers or flukes). Decomposition of the remaining animals prevented determination of the cause of death. Earlier reports of harbor porpoise entangled in gillnets in Chesapeake Bay and along the New Jersey coast and reports of apparent mutilation of harbor porpoise carcasses raised concern that the 1993 strandings were related to a coastal net fishery, such as the American shad coastal gillnet fishery (Haley and Read 1993). Between 1994 and 1996, 107 harbor porpoise carcasses were recovered from beaches in Maryland, Virginia, and North Carolina and investigated by scientists. Only juvenile harbor porpoises were present in this sample. Of the 40 harbor porpoises for which cause of death could be established, 25 displayed definitive evidence of entanglement in fishing gear. In 4 cases it was possible to determine that the animal was entangled in monofilament nets (Cox *et al*. 1998).

Records of harbor porpoise strandings prior to 1997 are stored in the Smithsonian's Marine Mammal Database and records from 1997 to present are stored in the NE Regional Office/NMFS strandings and entanglement database. According to these records, the numbers of harbor porpoises that stranded on U.S. beaches from North Carolina to Maine during 1994 to 2005 were 106, 86, 94, 118, 59, 228, 27, 113, 79, 122, 118, and 174 respectively (Table 4). Of these, 3 stranded alive on a Massachusetts beach in 1996, were tagged, and subsequently released. In 1998, 2 porpoises that stranded on a New Jersey beach had tags on them indicating they were originally taken on an observed mid-Atlantic gillnet vessel. During 1999, 6 animals stranded alive and were either tagged and released or brought to Mystic Aquarium for rehabilitation (Table 4).

During 1999, over half of the strandings occurred on beaches of Massachusetts and North Carolina. The states with the next largest numbers were Virginia, New Jersey and Maryland, in that order. The cause of death was investigated for all the 1999 strandings. Of these, it was possible to determine that the cause of death of 38 animals was fishery interactions. Of these 38, 19 animals were in an area and time that were not part of a bycatch estimate derived using observer data. Thus, these 19 mortalities are attributed to an unknown gillnet fishery. One additional animal was found mutilated (right flipper and fluke was cut off) and cause of death was attributed to an unknown human-caused mortality.

During 2000, only 27 harbor porpoises stranded on beaches from Maine to North Carolina (Table 4). Of these, most came from Massachusetts (8) or North Carolina (6). The cause of death for 1 animal was in an area and time that was not part of a bycatch estimate derived from observer data, and thus was attributed to an unknown gillnet fishery (Table 3). This animal was found on a beach in Virginia during May with mono-filament line wrapped around it. In addition, 1 animal was found mutilated and so cause of death was attributed to an unknown human-caused mortality.

During 2001, 113 harbor porpoises were reported stranded on an Atlantic US beach, of these most came from Massachusetts (39), Virginia (28), and North Carolina (21) (Table 4). Thirteen of these strandings displayed signs of fishery interactions, and of these, 3 animals were in an area and time that were not part of a bycatch estimate derived from the observer data (Table 3).

During 2002, 79 82 harbor porpoises were reported stranded on an Atlantic US beaches, of which over half come from Massachusetts (4243) (Table 4). Eleven animals displayed signs of emaciation and two showed signs of fishery interactions (Table 4). Both of the strandings with fishery interactions were in the mid-Atlantic (Maryland and Virginia) during March and were not in a time and area that was part of a bycatch estimate derived from observer data (Table 3).

During 2003, 122 harbor porpoises were reported stranded, of which approximately 1/3 came from Massachusetts (35) and an additional 1/3 came from North Carolina (39) (Table 4). The number of reported fishery interactions by state are: 1 in Massachusetts (October), 1 in Maryland (March), 6 in Virginia (3 in March, 2 in April, and 1 in May), and 1 in North Carolina (February). Three harbor porpoises were reported mutilated in North Carolina. All of these strandings reported with fishery interactions were in areas and times that were not part of a bycatch estimate derived from the observer data (Table 3).

During 2004, 118 1167 harbor porpoises were reported stranded on an Atlantic US beaches, of which about 40% came from Massachusetts (4948) (Table 4). There were 16 15 strandings in Maine, the highest number for Maine on recent record. There were 8 reported fishery interactions by state are: 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, ~~174~~ 17~~6~~5 harbor porpoises were reported stranded on Atlantic US beaches~~, of which approximately 1/3 stranded in Massachusetts (53~~55~~) and another ¼ (42) stranded in North Carolina~~. 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 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 common symptoms other than emaciation or any systemic disease (MMC 2006).

During 2006, 73 harbor porpoises were reported stranded on Atlantic US 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.

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. Averaging ~~2001~~ 2002 to 2004, there were ~~1.2~~ 0.8 animals per year that were stranded and mutilated and so cause of death was attributed to an unknown human-caused mortality.

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, 2002-2006.

Area	Year					**Total**
	2002	2003	2004	2005	2006	
Maine[a]	10	5	15	9	9	**48**
New Hampshire	2	2	2	0	1	**7**
Massachusetts[b]	43	35	49	55	23	**205**
Rhode Island[c]	1	2	3	6	3	**15**
Connecticut	1	0	0	1	0	**2**
New York	6	8	8	15	11	**48**
New Jersey	6	5	14	17	6	**48**
Pennsylvania	0	0	0	1	0	**1**
Delaware	3	1	1	3	3	**11**
Maryland	1	5	2	4	2	**14**
Virginia	6	19	8	22	9	**64**
North Carolina[d]	3	39	15	42	6	**105**
Florida	0	1	0	0	0	**1**
TOTAL U.S.	**82**	**122**	**117**	**175**	**73**	**569**
Nova Scotia	5	3	4	6	4	**22**
GRAND TOTAL	**87**	**125**	**121**	**181**	**77**	**591**

a. In Maine, one animal stranded alive in March 2002, brought to Mystic Aquarium but died 2 days later.
b. In Massachusetts, during 2002, three animals stranded alive and were rehabilitated at Mystic Aquarium (1 in February, March and May). In 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 unsucessful.

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

d. In North Carolina, one animal was relocated and released in 2005.

Table 4. Harbor Porpoise (*Phocoena phocoena*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2001-2005.						
Area	Year					**Total**
	2001	2002	2003	2004	2005	
Maine[a]	4	8	5	16	9	**42**
New Hampshire	0	2	2	2	0	**6**
Massachusetts[b]	39	42	35	49	53	**218**
Rhode Island	1	1	2	3	6	**13**
Connecticut	0	1	0	0	1	**2**
New York[c]	7	6	8	8	15	**44**
New Jersey	6	6	5	14	17	**48**
Delaware	3	3	1	1	3	**11**
Pennsylvania					1	**1**
Maryland	4	1	5	2	4	**16**
Virginia	28	6	19	8	22	**83**
North Carolina[d]	21	3	39	15	42	**120**
Florida	0	0	1	0	0	**1**
EEZ					1	**1**
TOTAL U.S.	**113**	**79**	**122**	**118**	**174**	**604**
Nova Scotia	2	5	3	4	6	**20**
GRAND TOTAL	**115**	**84**	**125**	**122**	**180**	**624**

a. In Maine, one animal stranded alive in March 2002, brought to Mystic Aquarium but died 2 days later.

b. In Massachusetts, during 1999, five animals stranded alive and were tagged and released. During 2002, three animals stranded alive and were rehabilitated at Mystic Aquarium (1 in February, March and May). In 2005, 2 animals were relocated and released.

c. In New York, one animal stranded alive in 1999, rehabilitated at Mystic Aquarium and died at the aquarium in April 2000.

d. In North Carolina, one animal was relocated and released in 2005.

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 Dept. of Fisheries and Oceans, Canada documented strandings on the beaches of Sable Island during 1970 to 1998 (Lucas and Hooker 2000). Sable Island is approximately 170km 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 ~~2005~~ 2006 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 4): 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), ~~and~~ 6 in 2005 (1 in April (released alive), 1 in May, 3 in June and 1 in July), and 4 in 2006 (1 in June, 1 in August, 1 in September, and ~~one~~1 in December).

USA Management measures taken to reduce bycatch

A ruling to reduce harbor porpoise bycatch in USA Atlantic gillnets was published in the Federal Register (63 FR 66464) on ~~01~~ 02 December 199~~0~~8 and became effective 01 January 1999. The Gulf of Maine portion of the plan pertains to all fishing with sink gillnets and other gillnets capable of catching ~~multispecies~~ 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 ~~multispecies~~ 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.

STATUS OF STOCK

The status of harbor porpoises, relative to OSP, in the U.S. Atlantic EEZ is unknown. On 7 January ~~7,~~ 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 ~~5,~~ 1999, NMFS determined the proposed listing was not warranted (NMFS 1999). On 2 August ~~2,~~ 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*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harbor seal is found in all nearshore waters of the Atlantic Ocean and adjoining seas above about 30ºN (Katona *et al*. 1993). 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).

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, ~~and New York~~ to New Jersey coasts from September through late May (Schneider and Payne 1983; Barlas 1999; ~~; Hoover *et al.* 1999; Slocum *et al.* 1999;~~ Schroeder 2000; deHart 2002). ~~In recent years, their seasonal interval along the southern New England to New Jersey coasts has increased (Barlas 1999; Hoover *et al.* 1999; Slocum *et al.* 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 n~~N~~o pupping areas ~~have been identified in~~ southern New England (Payne and Schneider 1984; Barlas 1999~~). ~~), m~~M~~ore recent information suggests that some pupping is occurring at high-use haulout sites off Manomet, Massachusetts (B. Rubinstein, pers. comm., New England Aquarium). 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~~ live-capture and ~~radio~~ 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~~; Slocum *et al.* 1999~~). 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).

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 Anglis 1997), and should not be used for PBR determinations. Therefore, only the 2001 estimate is useful for population assessment. 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 for 2001 is 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~~ Northeast region has also been

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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; ~~Hoover *et al*. 1999; Slocum *et al*. 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 1980's, 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 ~~less~~ 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 moving 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 ~~during~~ in June 1995, 1996, and 1997, and in August ~~during~~ 1994, 1995, 1996 and 1997; ~~and in~~ different ~~parts~~ portions of the Gulf were surveyed ~~during~~ 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 a 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).

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

Month/Year	**Area**	**N_{best}[a]**	**CV**
May/June 2001	Maine coast	99,340 (23,722)[b]	CV=.097

[a] Pup counts are in brackets
[b] Corrected estimate based on uncorrected count of 38,011 (9,278)

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 seals is 99,340 (CV=.097). The minimum population estimate is 91,546 based on corrected total counts along the Maine coast in 2001.

Current Population Trend

Between 1981 and 2001, the uncorrected counts of seals increased from 10,543 to 38,014, an annual rate of 6.6 percent (Gilbert *et al*. 2005).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this population. Based on uncorrected haulout counts over the 1981 to 2001 survey period, the harbor seal population is growing at approximately 6.6% (Gilbert *et al.* 2005). However, a population grows at the maximum growth rate (~~R_{MAX}~~ 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}~~ 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 minimum population size is 91,546. The recovery factor (F_R) for this stock is 0.5, the value for stocks of unknown status. PBR for U.S. waters is 2,746.

ANNUAL HUMAN-CAUSED MORTALITY

For the period ~~2001~~2002-~~2005~~ 2006 the total human caused mortality and serious injury to harbor seals is estimated to be ~~893~~ 621 per year. The average ~~is~~ was derived from ~~three~~ two components: 1) ~~882~~ 611 (CV=0.~~16~~15); Table 2) from the ~~2001~~2002-~~2005~~ 2006 observed fishery; and 2) 10 from average ~~2001~~2002-~~2005~~ 2006 non-fishery related, human interaction stranding mortalities (NMFS unpublished data~~); and 3) 1 incidental scientific take in 2001 (Waring 2006)~~.

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). However, no data are available to determine whether shooting still takes place.

Fishery Information

Detailed 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 ~~542~~ 545 harbor seal mortalities observed in the Northeast sink gillnet fishery between 1990 and ~~2005~~2006, 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. 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, ~~and~~ 719 (0.20) in 2005, and 87 (.58) in 2006 (Table 2). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). There were ~~8,~~ 2, 2, 9, ~~and~~ 14, and 8 unidentified seals observed during ~~2001~~2002-~~2005~~2006, 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 ~~2001~~2002-~~2005~~ 2006 was ~~862~~ 585 harbor seals (CV=0.~~16~~15) (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 in 2004, ~~and~~ two in 2005, and one in 2006. 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, ~~and~~ 63 (0.67) in 2005, and 26 (.98) in 2006. 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 ~~2001~~2002-~~2005~~ 2006 was ~~20~~ 26 (CV = 0.~~57~~49) harbor seals (Table 2).

Northeast Bottom Trawl

Two harbor seal mortalities were observed between 2001 and ~~2005~~ 2006, one in 2002 and one in 2005. (Table 2). ~~Observer coverage, expressed as number of trips, was < 1% from 1998 to 2001, and 2% in 2002 (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 and 2 in 2005. 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*) 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	Vessels	Data Type[a]	Observer Coverage[b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet[c]	~~01~~02-~~05~~06	unk[d]	Obs. Data, Weighout, Logbooks	~~.04,~~ .02, .03, .06, .07, .04	~~32,~~ 12, 21, 45, 70, 3	~~1471,~~ 787, 542, 792, 719, 87	~~.38,~~ .32, .28, .34, .20, .58	~~862~~ 585 (0.~~16~~15)
Mid-Atlantic Gillnet	~~01~~02-~~05~~ 06	unk[d]	Obs. Data, Weighout	~~.02,~~ .01, .01, .02, .03, .04	0, unk[e], 0, 1, 2, 1	~~0,~~ unk[e], 0, 15, 63, 26	~~0,~~ unk[e], 0, .86, .67, .98	~~20~~ 26 (0.~~57~~49)[e]
Northeast Bottom Trawl	~~01~~02-~~05~~ 06	unk[d]	Obs. Data, Weighout	~~.01,~~ .03, .04 .05, .12, .06	~~0,~~ 1, 0, 0, 1, 0	~~0,~~ unk[f], 0, 0, unk[f], 0	~~0,~~ unk[f], 0, 0, unk[f], 0	unk[f]
TOTAL								~~882~~611 (0.~~16~~15)

[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 northease 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 ~~2001~~ 2002 - ~~2005~~2006, respectively, ~~8, 10,~~ 3, 0, 8, 3, 3 takes were observed in nets with pingers. In ~~2001~~ 2002 – ~~2005~~2006, respectively, ~~22,~~ 9, 21, 37, 67, and 0 takes were observed in nets without pingers.

[d] Number of vessels is not known.

[e] Sixty-five percent of sampling in the mid-Atlantic coastal gillnet by the NEFSC fisheries observer program was concentrated in one area off the coast of Virginia. Because of the low level of sampling that was not distributed proportionately throughout the mid-Atlantic region observed mortality is considered unknown in 2002. The four year average (~~2001, and~~ 2003- ~~2005~~2006) estimated mortality was applied as the best representative estimate.

[f] Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery for the years ~~2001~~2002-~~2005~~ 2006 has not been generated.

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Other Mortality

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

Currently, aquaculture operations in eastern Canada are licensed to shoot nuisance seals, but the number of seals killed is unknown (Baird 2001). Other sources of harbor seal mortality include human interactions, storms, abandonment by the mother, disease, and predation (Katona *et al.* 1993; Jacobs and

Terhune 2000; NMFS unpublished data). Mortalities caused by human interactions include boat strikes, fishing gear interactions, power plant entrainment, 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 ~~2001~~2002~~-~~ to ~~2005~~2006, ~~1,717~~~~2,162~~1857 harbor seal stranding mortalities were reported in all states between Maine and ~~North Carolina~~ Florida (Table 3; NMFS unpublished data). ~~Sixty-eight~~~~Seventy-one~~Sixty-two (~~4.0~~3.~~2~~3%) of the seals stranded during this five year period showed signs of human interaction (~~9 in 2001, 18~~10 in 2002, ~~2~~ 15 in 2003, 15 in 2004, ~~and 24~~14 in 2005, and ~~12~~8 in 2006), with ~~17~~ ~~21~~23 having some sign of fishery interaction (~~1 in 2001, 9~~4 in 2002, ~~0~~ 8 in 2003, 3 in 2004, ~~and 4~~0 in 2005, and ~~5~~8 in 2006). 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 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*) stranding mortalities along the U.S. Atlantic coast (2001-2005)[a].~~

~~State~~	~~2001~~	~~2002~~	~~2003[b]~~	~~2004[b]~~	~~2005~~	~~Total~~
~~ME~~	~~85~~	~~149~~	~~212~~	~~358~~	~~148~~	~~952~~
~~NH~~	~~5~~	~~2~~	~~15~~	~~21~~	~~31~~	~~74~~
~~MA~~	~~57~~	~~90~~	~~98~~	~~146~~	~~112~~	~~503~~
~~RI~~	~~5~~	~~4~~	~~12~~	~~11~~	~~4~~	~~36~~
~~CT~~	~~4~~	-	~~1~~	~~3~~	~~2~~	~~10~~
~~NY~~	~~12~~	~~8~~	~~10~~	~~14~~	~~23~~	~~67~~
~~NJ~~	~~4~~	~~6~~	~~15~~	~~5~~	~~4~~	~~34~~
~~DE~~	-	-	~~2~~	-	~~4~~	~~6~~
~~MD~~	-	-	~~1~~	~~1~~	~~3~~	~~5~~
~~VA~~	~~2~~	~~1~~	~~2~~	~~1~~	~~3~~	~~9~~
~~NC~~	~~3~~	~~2~~	~~8~~	-	~~7~~	~~20~~
~~FL~~	-	-	~~1~~	-	-	~~1~~
~~Total~~	~~177~~	~~262~~	~~377~~	~~560~~	~~341~~	~~1717~~
~~Unspecified seals (all states)~~	~~37~~	~~35~~	~~27~~	~~33~~	~~59~~	~~191~~

~~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. Live releases and rehabbed animals have been eliminated~~

~~b. Unusual Mortality Event (UME) declared for harbor seals in northern Gulf of Maine waters during 2003-2004.~~

Table 3. Harbor seal (*Phoca vitulina*) stranding mortalities along the U.S. Atlantic coast (2002-2006)[a].

State	2002	2003[b]	2004[b]	2005	2006	Total
ME	~~149~~81	~~212~~169	~~358~~348	~~148~~121	~~448~~371	~~1315~~1090
NH	~~2~~3	15	21	31	~~31~~28	~~100~~98

MA	~~90~~81	~~98~~88	~~146~~150	~~112~~101	~~99~~94	~~545~~514
RI	~~4~~3	~~12~~8	11	~~4~~3	~~8~~6	~~39~~31
CT		~~1~~0	~~3~~1	2	~~2~~1	~~8~~4
NY	~~8~~6	~~10~~7	~~14~~12	~~23~~22	~~15~~11	~~70~~58
NJ	~~6~~4	~~15~~7	5	~~4~~1	~~10~~7	~~40~~24
DE		~~2~~1		~~4~~3	~~1~~2~~1~~	~~7~~6
MD		~~1~~0	~~1~~0	~~3~~2		~~5~~2
VA	~~1~~0	~~2~~0	~~1~~2	3	~~3~~2	~~10~~7
NC	2	8		7	4	21
FL		1			1~~1~~	2
Total	~~262~~180	~~377~~304	~~560~~550	~~341~~296	~~622~~527	~~2162~~1857
Unspecified seals (all states)	35	27	33	59	46	200

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.

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 not less than 10% of the calculated PBR and, therefore, cannot be considered to be approaching zero mortality and serious injury rate. This is not a strategic stock because fishery-related mortality and serious injury does not exceed PBR.

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GRAY SEAL (*Halichoerus 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 England to Labrador (Mansfield 1966; Katona *et al.* 1993; Davies 1957; Lesage and Hammill 2001). This stock is separated by geography, differences in the breeding season, and mitochondrial DNA variation from the north~~w~~eastern 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). 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 at the Monomoy National Wildlife Refuge~~ (NWR; S. Wood, pers. comm., University of Massachusetts, Boston, MA)~~. Gilbert (pers. comm.) has also documented resident colonies and pupping in Maine since 1994.

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 (DFO 2003, Mohn and Bowen 1996), a 1997 survey estimated 195,000 (DFO 2003), and a 2004 survey ~~estimated~~ 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 indicate this population increase has 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).

The population in US waters is also increasing. Maine coast-wide surveys conducted during summer (all other surveys were conducted January-May) revealed 597 and 1,731 gray seals in 1993 and 2001, respectively (Gilbert *et al*. 2005). In 2002, the maximum counts of two breeding colonies in Maine, with number of pups in parentheses, were 193 (9) on Seal Island and 74 (31) on Green Island (S. Wood, pers. comm.). Gray seal numbers are increasing in Massachusetts at Muskeget Island off the coast of Nantucket, and at Monomoy Island, off the coast of Chatham, Cape Cod. Pup counts on Muskeget have increased from 0 in 1989 to 1,023 in 2002 (Rough 1995, S. Wood, pers. comm.). Gray seal numbers increase in this region in the spring (April-May) when molting occurs. In April-May 1994 a maximum count of 2,010 was obtained for Muskeget Island and Monomoy combined (Rough 1995). In March 1999 a maximum count of 5,611 was obtained in the region south of Maine (between Isles of Shoals, ~~NH~~ Maine and Woods Hole, ~~MA~~Massachusetts) (Barlas 1999). No gray seals were recorded at haul out sites between Newport, Rhode Island~~I~~ and Montauk Pt., New York (Barlas 1999), although, more recently small numbers of gray seals have been recorded in this region (deHart 2002; R. DiGiovanni, pers. comm., The Riverhead Foundation, Riverhead, NY). Recently, a small number of gray seals have maintained a winter presence in the Woods Hole region (Vineyard Sound) (deHart 2002).

Table 1. Summary of abundance estimates for the western North Atlantic gray seal. Month, year, and area covered during each abundance survey, resulting abundance estimate (N_{min} N_{best}) and coefficient of variation (CV).			
Month/Year	**Area**	**Nmin**[a] **Nbest**	**CV**
March 1999	Muskeget Island and Monomoy NWR, MA	5,611	None reported
May 2001[a]	Maine coast	1,731	None reportedNA
January 2004[b]	Gulf of St Lawrence + Nova Scotia Eastern Shore	52,50046,300	0.15
January 2004[b]	Sable Island	208,720125,541 216,490 144,610 223,220169,064	0.14 0.11 0.08None reported

[a] These counts pertain to animals seen in U.S. waters, and the stock relationship to animals in Canadian waters is unknown.
[b] These are model based estimates derived from pup surveys.

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 Zwanenberg 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).

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, between 883 900 and 1,023 000 pups were counted on Muskeget Island and surrounding shoals (S. Wood, pers. comm.). In recent years NMFS monitoring surveys have detected an occasional mother/pup (white coats) pair on both Monomoy Island and Nomans Land Island. These observations continue the increasing trend in pup production reported by Rough (1995). NMFS recently initiated a collaborative program with the University of Massachusetts, Boston and University of Maine to monitor gray seal population trends and pup production in New England waters. The change in gray seal counts at Muskeget and Monomoy from 2,010 in 1994 to 5,611 in 1999 represents an annual increase rate of 20.5%, , however, it can not be determined what proportion of the increase represents growth or immigration.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. A recent study estimated the 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 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 ~~2001~~2002-~~2005~~2006, the total estimated human caused mortality and serious injury to gray seals was ~~445~~ 836 per year. The average was derived from three components: 1) ~~304~~ 331 (CV=0.~~22~~21) (Table 2) from the ~~2001~~2002-~~2005~~ 2006 U.S. observed fishery; 2) ~~3~~ 2 from average ~~2001~~2002-~~2005~~ 2006 non-fishery related, human interaction stranding mortalities (NMFS unpublished data); and 3) ~~138~~ 503 from average ~~2000~~2002-~~2003~~ 2006 kill in the Canadian hunt (DFO 2003, G. Stenson unpublished data; ~~2004 and 2005 data not yet available, but possibly higher due to recently increased TAC levels~~M.~~ike~~ Hammill pers.comm., DFO, Mont-Joli, Quebec).

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 ~~96~~ 105 gray seal mortalities observed in the Northeast sink gillnet fishery between 1993 and ~~2005~~2006. 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, ~~and~~ 574 (0.44) in 2005, and 314 (0.22) in 2006 (Table 2). There were ~~5, 8,~~ 2, 2, 9, ~~and~~ 14, and 8 unidentified seals observed during ~~2001~~2002-~~2005~~2006, 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 ~~2001~~2002-~~2005~~ 2006 was ~~287~~ 314 gray seals (CV=0.~~23~~22) (Table 2). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996).

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Mid-Atlantic Coastal Gillnet

No gray seals were taken in observed trips during 1998-2000, ~~and~~ 2003, and 2006. One gray seal was observed taken in both 2001and ~~and one in~~ 2004 (Table 2). In 2001 the gray seal was taken ~~at 44 fathom depth during the month of~~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 ~~50~~ 90 km~~iles~~ 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 fisher-related mortality and serious injury to this stock attributable to this fishery during ~~2001~~2002-~~2005~~ 2006 was 17 gray seals (CV=0.92) (Table 2).

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 and 19 in 2005. In addition, 5 seals of unknown species were captured and released alive in 2004 and 2 in 2005.

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. The estimated annual fishery-related mortality and serious injury attributable to this fishery was 0 between 2001 and 2004, and for 2006.

Estimates have not been generated for 2005.

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 1970's and early 1980's 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 2. Summary of the incidental mortality of gray seal (*Halichoerus grypus*) 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	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet [c]	~~01~~02-~~05~~06	unk	Obs. Data, Weighout, Logbooks	~~.04,~~ .02, .03, .06, .07, .04,	~~2,~~ 0, 5, 21, 33, 9	~~117,~~ 0, 242, 504, 574, 248	~~.59,~~ 0, .47, .34, .44, .47	~~287~~ 314 (0.~~23~~22)
Mid-Atlantic Gillnet	~~01~~02-~~05~~06	unk	Obs. Data, Weighout	~~.02,~~ .01, .01, .02, .03, .04	~~1,~~ unk[e], 0, 1, 0, 0	~~0[d],~~ ~~unk[e]~~ unk[d], 0, 69, 0, 0	~~0,~~ ~~unk[e]~~ unk[d], 0, .92, 0, 0	17[d] (0.92)
Northeast Bottom Trawl	~~01~~02-~~05~~06	unk	Obs. Data, Weighout	~~.01,~~ .03, .04, .05, .12, .06	~~0,~~ 0, 0, 0, 4, 0	~~0,~~ 0, 0, 0, unk[f], 0	~~0,~~ 0, 0, 0, unk[f], 0	unk[f]
TOTAL								~~304~~331 (0.~~22~~21)

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 1998, 1 take was observed in a net without a pinger that was within a marine mammal closure that required pingers. In ~~2001~~ 2002 - ~~2005~~2006, respectively, ~~0,~~ 0, 1, 1, 1, and 1 takes were observed in nets with pingers. In ~~2001~~ 2002 – ~~2005~~2006, respectively, 2, 0, 4, 20, 32, and 8 takes were observed in nets without pingers.

~~d. The one observed take in the mid-Atlantic gillnet fisheries (2001) was on a "fish trip", therefore no mortality estimate was extrapolated. See Bisack (1997) for "trip" type definitions.~~

~~e~~d. Sixty-five percent of sampling in the mid-Atlantic coastal gillnet by the Northeast Fisheries Observer Program was concentrated in one area off the coast of Virginia. Because of the low level of sampling that was not distributed proportionately throughout the

mid-Atlantic region observed mortality is considered unknown in 2002. The four year average (~~2001, and~~ 2003- ~~2005~~2006) estimated mortality was applied as the best representative estimate.
f. 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 (Lavigueur and Hammill 1993). Between 1999 ~~-2003~~ and 2006 the annual kill of gray seals by hunters in Canada was: 1999 (98), 2000 (342), 2001 (76) 2002 (126), ~~and~~ 2003 (6), 2004 (0), 2005 (579), and 2006 (1804). (DFO 2003; ~~Stenson unpublished data~~M.~~ike~~ Hammill per.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 an annual (2006-2010) TAC of 2,100 gray seals in the Gulf of St. Lawrence, and 8,300 on the Scotian Shelf. The hunting of grey 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. This hunt may have severely depleted this stock in U.S. waters (Rough 1995). 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 ~~2001~~2002-~~2005~~2006, ~~246~~ 213 gray seal stranding mortalities were recorded, extending from Maine to North Carolina (Table 3; NMFS unpublished data). Most stranding mortalities were in Massachusetts. Thirty-~~-four~~seven (~~12.4~~17.4%) of the total stranding mortalities showed signs of human interaction (~~2 in 2001,~~ 6 in 2002, 7 in 2003, 16 in 2004 ~~and~~, 3 in 2005, and 5 in 2006), with ~~21~~ 25 having some indication of fishery interaction (~~1 in 2001,~~ 3 in 2002, 5 in 2003, 11 in 2004 ~~and~~ , 1 in 2005, and 5 in 2006).

Table 3. Gray seal (*Halichoerus grypus*) stranding mortalities along the U.S. Atlantic coast (2002-2006)[a].

State	2002	2003	2004	2005	2006	Total
ME	2	2	3	4	3	14
NH		1				1
MA	32	58	33	26	29	178
RI	1	6	8	2	2	19
CT			2			2
NY	5	5	2	7	6	25
NJ		2		2	1	4
DE			1			1
MD			1	3		4
VA		1	2	1		4
NC	1				2	1
Total	41	75	52	45	43	213
Unspecified seals (all states)	35	27	33	59	46	200

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. Live releases and rehabbed animals have been eliminated. Mortalities include those which stranded dead, died at site, were euthanized, died during transport, or died soon after transfer to rehab.

Table 3. Gray seal (*Halichoerus grypus*) stranding mortalities along the U.S. Atlantic coast (2001-2005)[a].

State	2001	2002	2003	2004	2005	Total
ME	2	2	2	3	4	13
NH	-	-	1	-	-	1
MA	20	32	58	33	26	169
RI	1	1	6	8	2	18
CT	-	-	-	2	-	2
NY	8	5	5	2	7	27
NJ	2	-	2	-	2	6
DE	-	-	-	1	-	1
MD	-	-	-	1	3	4
VA	-	-	1	2	1	4
NC	-	1	-	-	-	1
Total	33	41	75	52	45	246
Unspecified seals (all states)	37	35	27	33	59	191

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. Live releases and rehabbed animals have been eliminated

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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(*Pseudoterranova decipiens*) in relation to its intermediate and seal hosts. Can. Bull. Fish. and Aq. Sci. 222.

HARP SEAL (*Phagophilus 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 ~~breeding~~ pupping site on the pack ice (Bonner 1990; Lavigne and Kovacs 1988). The largest stock is located off eastern Canada and is divided into two breeding herds~~ which breed on the pack ice~~. 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 mid-February and April. Adults then assemble north of their whelping patches 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.

In recent years, 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; Stevick and Fernald 1998; McAlpine 1999; Lacoste and Stenson 2000; B. Rubinstein, pers. comm., New England Aquarium). 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 seals (95% CI= 4.5-6.4 million) harp seals~~,~~. (Healey and Stenson 2000). The estimate based on the 2004 survey was calculated at ~~which was not significantly different from the 2004 estimate of~~ 5.~~9~~ 82 million (95% CI=4.~~6~~1-~~72~~7.6~~.~~ million, ~~DFO 2005~~Hammill and Stenson 2005) but has been subsequently revised to 5.5 million (95% CI=3.8 - 7.1 million; ~~(~~Table 1)(DFO 2007).~~.~~

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
2000	Front and Gulf	5.5 million	(95% CI 4.5-6.4 million)
2004	Front and Gulf	5.~~9~~ 5 million	(95% CI ~~4.6~~3.8-7.~~2~~ 1 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 5.~~9~~ 5 million (SE = ~~660,000~~856,645)~~)~~(DFO 2007~~DFO 2005~~). The minimum population estimate based on the 2004 pup survey results is 288,000~~5.3 million~~ 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; Bowen and Sergeant 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) suggests that the increase in pup production observed throughout the 1990s may have abated (Stenson *et al*. 2005).

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. In Canada the 2004 pup production estimate suggests that the increase in pup production observed throughout the 1990s has likely stopped (Stenson *et al*. 2005).

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. 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 321,000 harp seals. However, Johnston *et al.* (2000) suggest that catch statistics from the Canadian hunt are negatively biased due to under reporting. Because of this, and because of biases in the current abundance estimate,~~;~~ ~~therefore,~~ ~~an~~ a more conservative F_R of 0.5 may be appropriate. Using the lower F_R results in a "PBR" of 160,000 harp seals. The Canadian model predicts replacement yields between 522,000 and 541,000 (Healey and Stenson 2000). The Canadian model predicts replacement yields between 522,000 and 541,000 (Healey and Stenson 2000). However, the PBR for the stock in US waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~2001~~2002-~~2005~~ 2006 the total estimated annual human caused mortality and serious injury to harp seals was ~~447,442~~443,299. This is derived from three components: 1) an average catch of ~~447,365~~443,216 seals from ~~2001~~2002-~~2005~~ 2006 by Canada (Table 2a); 2) ~~73~~ 80 harp seals (CV=0.~~27~~31) from the observed U.S. fisheries (Table 2b); and 3) ~~four~~ three harp seals from average ~~2001~~2002-~~2005~~ 2006 non-fishery related, human interaction stranding mortalities (NMFS unpublished data). 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	**2002**	**2003**	**2004**	**2005**	**2006**		**Average**
Commercial catches[a]	312,367	289,512	365,971	329,829	354,867		**330,509**
Commercial catch struck and lost[b]	30,275	24,084	31,026	23,071	26,674		**27,026**
Greenland subsistence catch[c]	69,895	68,499	70,585	91,361			**75,085**
Canadian Arctic[d]	715	715	715	715[d]			**715**
Greenland and Canadian Arctic struck and lost[e]	70,610	69,214	71,300	91,361			**75,621**
Newfoundland lumpfish[f]	9,329	5,367	12,290	11,597[f]			**8,995**

Total	493,191	457,391	551,887	535,622	381,541	443,216

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	2001	2002	2003	2004	2005	Average
Commercial catches[a]	226,493	312,367	289,512	365,971	329,829	304,834
Commercial catch struck and lost[b]	16,607	22,190	18,678	23,887	23,071	20,887
Greenland subsistence catch[c]	89,617	69,895	68,499	67,064	68,486	72,712
Canadian Arctic[d]	405	715	715	715	715[d]	653
Greenland and Canadian Arctic struck and lost[e]	45,011	35,305	34,607	33,889	34,600[e]	36,682
Newfoundland lumpfish[f]	19,400	9,329	5,367	12,290	11,597[f]	11,597
Total	397,533	449,801	417,378	503,816	468,298	447,365

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; 2002-2004 average used for 2005.

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.

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 140 143 harp seal mortalities observed in the Northeast sink gillnet fishery between 1990 and 20052006. The bycatch occurred principally in winter (January-May) and was mainly in waters between Cape Ann and New Hampshire. One observed winter mortality was in waters south 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, and 35 (0.68) in 2005, and 65 (0.66) in 2006 (Table 2b). There were also 8, 2, 2, 9, and 14, and 8 unidentified seals observed during 2001 2002 through 2005 2006 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 20012002-2005 2006 was 73 80 harp seals (CV=0.2731) (Table 2b).

Mid-Atlantic Gillnet:

No harp seals were taken in observed trips during 1993-1997, and 1999-20052006. One harp seal was observed taken in 1998. Observed effort from 1993~~-~~ to ~~2004~~ 2006 was scattered between New York and North Carolina from 1 to ~~50~~ 9 km ~~miles~~ 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) and 0 in 1999-2005. 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 ~~2001~~2002-~~2005~~ 2006 was zero harp seals.

Northeast Bottom Trawl

~~Four~~ Three mortalities were observed in the ~~northeast~~ Northeast bottom trawl fishery between ~~2001and~~ 2002 and ~~2005~~2006. 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 between 2002 and 2004, and in 2006. Estimates have not been generated for 2005.

Table 2b. Summary of the incidental mortality of harp seal (~~*Phoca*~~ *Pagophilus* ~~*groenlandica*~~*groenlandicus*) 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	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality[c]	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	~~01~~02-~~05~~06	unk	Obs. Data Weighout, Logbooks	~~.06,~~ .04, .02, .03, .06, .07, .04	~~1,~~ 0, 0, 15, 3, 3	~~26,~~ 0, 0, 303, 35, 65	~~1.04,~~ 0, 0, .30, .68, .66	~~73~~ 80 (0.~~27~~31)
Northeast Bottom Trawl	~~01~~02-~~05~~ 06	unk	Obs. Data Weighout	~~.01,~~ .03, .04 .05, .12, .06	~~1,~~ 0, 0, 0, 3, 0	~~49,~~ 0, 0, 0, unk, 0	~~1,~~ 10, 0, 0, 0, unk, 0	unk
TOTAL								~~73~~ 80 (0.~~27~~31)

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 - ~~2005~~2006, respectively, 2, 1, 0, 0, 4, 0, and 3 takes were observed in nets with pingers. In 2000 – ~~2005~~2006, respectively, 1, 0, 0, 0, 11, 3, and 0 takes were observed in nets without pingers.
d. Bycatch estimates attributed to the Northeast bottom trawl fishery have not been generated.

Other Mortality

U.S.: From ~~2001~~ 2002 to ~~2005~~2005, ~~816~~ ~~568~~456 harp seal stranding mortalities were reported (Table 3; NMFS unpublished data). ~~Factors contributing to the high number of stranding mortalities in 2001 are unknown (Harris *et al.* 2002). Twenty-five Seventeen~~Thirteen (~~3~~2.8~~.1~~%) of the mortalities during this five-year period showed signs of human interaction (~~10 in 2001, 5~~2 in 2002, 2 in 2003, 2 in 2004, ~~and 6~~5 in 2005, and 2 in 2006), with ~~5~~ 1 having some sign of fishery interaction (~~4 in 2001and~~ 1 in 2005). Harris and Gupta (2006) analyzed NMFS 1996-2002 stranding data and suggest that the distribution of harp seal stranding in the Gulf of Maine is consistent with the species' seasonal migratory patterns in this region.

Table 3. Harp seal (*Pagophilus groenlandicus*) stranding mortalities along the U.S. Atlantic coast (2002-2006)[a].

State	2002	2003	2004	2005	2006	Total
ME	116	75	3021	10	1412	7254
NH	-	-	-	2	-	2
MA	5750	2923	9185	5144	3524	263226
RI	85	3	97	129	76	3930
CT	85	10	2	3	54	1914
NY	2215	115	2520	4241	2215	12296
NJ	71	-	76	1312	83	3522
DE	-	1	10	2	-	43
MD	-	-	-	2	-	2
VA	21	-	31	4	-	96
NC	-	-	-	-	1	1
Total	**11583**	**5237**	**168142**	**141129**	**9265**	**568456**
Unspecified seals (all states)	35	27	33	59	46	200

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. 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.

Table 3. Harp seal (*Phoca groenlandica*) stranding mortalities along the U.S. Atlantic coast (2001-2005)[a].

State	2001	2002	2003	2004	2005	Total
ME	49	11	7	30	10	107
NH	4	-	-	-	2	6
MA	168	57	29	91	51	396
RI	28	8	3	9	12	60
CT	7	8	1	2	3	21
NY	62	22	11	25	42	162
NJ	15	7	-	7	13	42
DE	1	-	1	1	2	5
MD	5	-	-	-	2	7
VA	1	2	-	3	4	10
Total	**340**	**115**	**52**	**168**	**141**	**816**
Unspecified seals (all states)	37	35	27	33	59	191

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. Live releases and rehabbed animals have been eliminated

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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