October 2007

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 2003 (NE Regional Office/NMFS strandings and entanglement database).

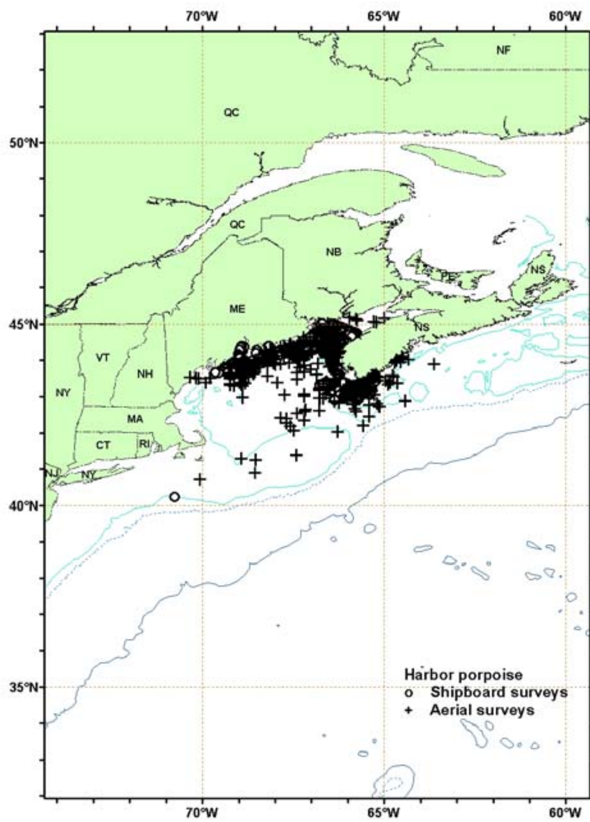

Figure 1. *Distribution of harbor porpoises from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, and 2006. Isobaths are the 100m, 1000m, and 4000m depth contours.*

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), 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)*. 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 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 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 734 (CV=0.16) harbor porpoises per year. This is derived from four components: 652 harbor porpoise per year (CV=0.16) from U.S. fisheries using observer and MMAP data, 77 per year (unknown CV) from Canadian fisheries using observer data, and 5.0 per year from U.S. unknown fisheries using strandings data.

Fishery Information

Recently, Gulf of Maine/Bay of Fundy harbor porpoise takes have been documented in the U.S. Northeast sink gillnet, mid-Atlantic gillnet, and 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 harbor porpoise mortalities related to this fishery observed between 1990 and 2005 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 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. 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).

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 to 2005 was 475 (0.16) (Table 2).

Mid-Atlantic Gillnet

Before an observer program was in place for this fishery, Polacheck *et al.* (1995) reported one harbor porpoise incidentally taken in shad nets in the York River, Virginia. In July 1993 an observer program was initiated in the mid-Atlantic gillnet fishery by the NEFSC Sea Sampling program (Appendix III). Documented bycatch after 1995 were 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. 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 to 2005 was 177 (0.40), which is the 4-year average estimate from 2001, 2003, 2004, and 2005.

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 stranded harbor porpoises on U.S. beaches during 1999 to 2005, 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 average harbor porpoise mortality and serious injury in this unknown fishery category from 2001 to 2004 is 5.0 (CV is unknown).

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. Seven harbor porpoise mortalities were observed in the North Atlantic bottom trawl fishery between 1989 and 2005. 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. Estimates have not been generated for this fishery.

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 July 20-31 and 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 July 18-31 and 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) in 1995; 2 (and 4) in 1996; 2 (and 24) in 1997; 2 (and 26) in 1998; 3 (and 89) in 1999; 0 (and 13) in 2000 (A. Read, pers. comm), 14 (and 296) 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 2001-2004 was 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	01-05	unk	Obs. Data, Weighout, Trip Logbook	.04, .02 .03, .06, .07	4[c,f], 10[c], 12[c], 27[c], 51[c]	53[c,f], 444[c], 592, 654[c], 630[c]	.97, .37, .33, .36, .23	475 (0.16)
Mid-Atlantic Gillnet	01-05	unk	Obs. Data Weighout	.02, .01, .01, .02, .03	1,unk[g], 1, 2, 15	26, unk[g], 76, 137, 470	.95, unk[g], 1.13, .91, .51	177[g] (0.40)
Northeast bottom trawl	01-05	unk	Obs. Data Weighout	.004, .021, .028 .045, unk	0,0,1,0,4	0,0,unk[i],0,unk[i]	0, 0, unk, 0, unk	unk[i]
U.S. TOTAL	2001-2005							652 (0.16)
CANADA								
Groundfish Sink Gillnet	01-05	unk	Can. Trips	56, 0[h],0[h], , 0[h], ,0[h]	39, unk[h], unk[h], unk[h] unk[h]	73, unk[h], unk[h], unk[h] unk[h]	unk	73 (unk)

Herring Weir	01-05	1998=255 licenses[d] 2002=22[e]	Coop. Data	unk	14, 3, 1, 4, 0	14, 3, 1, 4, 0	NA	4.4 (unk)
CANADIAN TOTAL	2000-2004							77 (unk)
GRAND TOTAL								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 2001-2005, 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 observed harbor porpoise takes on pinger trips from 1992 to 2005, 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 observed harbor porpoise takes in 1995 to 2005, 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) estimated mortality was applied as the best representative estimate.

h. The Canadian gillnet fishery was not observed during 2002 and afterwards, but the fishery 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	01-05	NA	Entanglement & Strandings	3, 2, 9, 6, unk[b]	5.0
TOTAL					5.0

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.

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 harbor porpoises were reported stranded on an Atlantic US beach, of which over half come from Massachusetts (42) (Table 4). Eleven animals displayed signs of emaciation and two 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 harbor porpoises were reported stranded on an Atlantic US beach, of which about 40% came from Massachusetts (49) (Table 4). There were 16 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 harbor porpoises were reported stranded on Atlantic US beaches, of which approximately 1/3 stranded in Massachusetts (53) 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).

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 to 2004, there were 1.2 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, 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 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 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).

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 December 1990 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 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 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 January 5, 1999, NMFS determined the proposed listing was not warranted (NMFS 1999). On 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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