December 2003

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

This stock is found in USA and Canadian Atlantic waters. The distribution of harbor porpoises has been documented by sighting surveys, strandings, and takes reported by NMFS observers in the Fisheries Observer 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. Though, 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 (Smithsonian strandings data base).

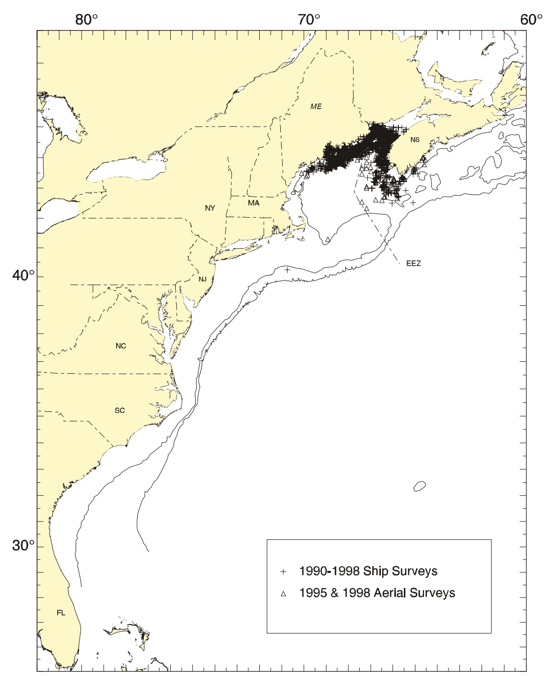

Figure 1. *Distribution of harbor porpoise sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1990-1998. Isobaths are at 100 m and 1,000 m.*

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 underway 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). This pattern 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; 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, four line-transect sighting surveys were conducted during the summers of 1991, 1992, 1995, and 1999 (Table 1; Figure 1). The estimates were 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), and 89,700 in 1999 (CV=0.22, 95% CI=53,400 - 150,900) (Palka 2000). 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). 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).

The shipboard sighting survey procedure used in all four surveys involved two independent teams on one ship that searched using the naked eye in non-closing mode. Abundance, corrected for *g(0)*, the probability of detecting an animal group on the track line, was estimated using the direct-duplicate method (Palka 1995a) and variability was estimated using bootstrap re-sampling methods. Potential biases not explicitly accounted for include ship avoidance and submergence time. The effects of these two potential biases are unknown. During 1995 and 1999 a section of the region was surveyed by airplane while the rest of the region was surveyed by ship, as in previous years (Palka 1996; 2000). During 1995, in addition to the Gulf of Maine/Bay of Fundy area, waters from Virginia to the mouth of the Gulf of St. Lawrence were surveyed and harbor porpoises were seen only in the vicinity of the Gulf of Maine/Bay of Fundy. During 1999, waters from south of Cape Cod to the mouth of the Gulf of St. Lawrence were surveyed (Palka 2000).

The best current abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock is 89,700 (CV=0.22), based on the 1999 survey results not averaged with other years. This is because the 1999 estimate is the most current, and this survey discovered portions of the harbor porpoise range not covered previously.

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, 8,427 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. 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)*.

Table 1. Summary of abundance estimates for the Gulf of Maine/Bay of Fundy harbor porpoise for the entire area that was surveyed and a common area that was surveyed in all years. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	Entire survey area		Common survey area
		N_{best}	CV	N
Jul-Sep 1995	N. Gulf of Maine & lower Bay of Fundy	74,000	0.20	71,900
Inverse variance-weighted average of above 1991, 1992 and 1995 estimates		54,300	0.14	-
Jul-Aug 1999	S. Gulf of Maine to upper Bay of Fundy	89,700	0.22	67,600

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 89,700 (CV=0.22). The minimum population estimate for the Gulf of Maine/Bay of Fundy harbor porpoise is 74,695 (CV=0.22).

Current Population Trend

Analyses are underway to determine if trend information can be obtained from the four NEFSC surveys. Previous abundance estimates for harbor porpoises in the Gulf of Maine/Bay of Fundy are available from earlier studies, (e.g., 4,000 animals (Gaskin 1977), and 15,800 animals (Kraus *et al.* 1983)). These estimates cannot be used in a trends analysis because they were for selected small regions within the entire known summer range and, in some cases, did not incorporate an estimate of *g(0)* (NEFSC 1992).

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 74,695 (CV=0.22). 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 Gulf of Maine/Bay of Fundy harbor porpoise is 747.

ANNUAL HUMAN-CAUSED MORTALITY

Data to estimate the mortality and serious injury of harbor porpoise come from USA and Canadian Fisheries Observer Programs, from records of strandings in USA waters, and from records in the Marine Mammal Authorization Program (MMAP). Estimates using Fisheries Observer 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 (Tables 4 to 5).

A take reduction plan was implemented 01 January 1999 to reduce takes of harbor porpoises in USA Atlantic gillnet fisheries. In addition, several New England and Mid-Atlantic Fishery Management Council plans that apply to parts of the gillnet fisheries were also implemented during 1999. Because these plans changed the USA gillnet fisheries, only 1999 to 2001 USA mortality estimates are representative of the current USA mortality.

The total annual estimated average human-caused mortality is 365 (CV=0.23) harbor porpoises per year. This is derived from four components: 310 harbor porpoise per year (CV=0.23) from USA fisheries using observer and MMAP data, 46 per year (unknown CV) from Canadian fisheries using observer data, 8 per year from USA unknown fisheries using strandings data, and 1 per year from unknown human-caused mortality (a mutilated stranded harbor porpoise).

Fishery Information

Recently, Gulf of Maine/Bay of Fundy harbor porpoise takes have been documented in the USA Northeast sink gillnet, mid-Atlantic coastal gillnet, and in the Canadian Bay of Fundy groundfish sink gillnet and herring weir fisheries (Table 2).

Earlier Interactions

Pelagic Drift Gillnet

In 1996 and 1997, NMFS issued management regulations which prohibited the operation of this fishery in 1997. The fishery operated during 1998. Then, in January 1999 NMFS issued a Final Rule to prohibit the use of drift net gear in the North Atlantic swordfish fishery (50 CFR Part 630). One harbor porpoise was observed taken from the Atlantic pelagic drift gillnet fishery during 1991-1998. The estimated total number of hauls in the Atlantic pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994 to 1998 there were 11, 12, 10, 0, and 11 vessels, respectively, in the fishery. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995 and 1996 were 233, 243, 232, 197, 164, and 149 respectively. Observer coverage, expressed as percent of sets observed was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, 64% in 1996, and 99% in 1998. The decline in observer coverage in 1996 is attributable to trips made by vessels that were deemed unsafe for observers due to the size or condition of the fishing vessel. Fishing effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras. Examination of the species composition of the catch and locations of the fishery throughout the year suggested that the drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total bycatch, for each year from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by stratum (Northridge 1996). Estimates of total annual bycatch after 1993 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in logbooks. Variances were estimated using bootstrap re-sampling techniques (Bisack 1997b). The one 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 in 1994 to 1996, and 0 in 1998. The fishery was closed during 1997. Average estimated harbor porpoise mortality and serious injury in the Atlantic pelagic drift gillnet fishery during 1994-1998 was 0.0.

USA

Recent data on incidental takes in USA fisheries are available from several sources. The only source that documented harbor porpoise bycatch is the Northeast Fisheries Science Center (NEFSC) Fisheries Observer Observer Program that was initiated in 1990, and since that year, several fisheries have been covered by the program.

Northeast Sink Gillnet

Before 1998 most of the documented harbor porpoise takes from USA fisheries were from the Northeast sink gillnet fishery. 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 eleven 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. There have been 454 harbor porpoise mortalities related to this fishery observed between 1990 and 2001 and one was released alive and uninjured. In 1993, there were approximately 349 full- and part-time vessels in the Northeast sink gillnet fishery (Table 2). An additional 187 vessels were reported to occasionally fish in the Gulf of Maine with gillnets for bait or personal use; however, these vessels were not covered by the observer program (Walden 1996) and their fishing effort was not used in estimating mortality. During 1998, an estimated 301 full- and part-time vessels participated in this fishery. This is the number of unique vessels in the commercial landings database (Weighout) that reported catch from this fishery during 1998 from the states of Rhode Island to Maine. This does not include a small percentage of records where the vessel number was missing. Observer coverage in terms of trips was 1%, 6%, 7%, 5%, 7%, 5%, 4%, 6%, 5%, 6%, 6% and 4% for 1990 to 2001, respectively. 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. Annual estimates of harbor porpoise bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Bycatch estimates included a correction factor for the under-recorded number of by-caught animals that occurred during unobserved hauls on trips with observers on the boat, when applicable. Need for such a correction became evident following re-analysis of data from the Fisheries Observer program indicating that for some years bycatch rates from unobserved hauls were lower than that for observed hauls. Further analytical details are given in Palka (1994), CUD (1994), and Bravington and Bisack (1996). These revised bycatch estimates replace those published earlier (Smith *et al.* 1993). Estimates presented here are still negatively biased because they do not include harbor porpoises that fell out of the net while still underwater. This bias cannot be quantified at this time. Estimated annual bycatch (CV in parentheses) from this fishery during 1990-2001 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), 2100 in 1994 (0.18), 1400 in 1995 (0.27) (Bisack 1997a), 1200 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), and 51 (0.97) in 2001. The increase in the 1998 and 2001 CV is mainly due to the small number of observed takes.

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 Jeffrey's 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 USA 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 to 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, a controlled scientific experiment was conducted in the southern Gulf of Maine, where all nets with and without active pingers were observed (Kraus *et al.* 1997). In this experiment 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. In addition, 17 other harbor porpoises were taken in nets that did not follow the experimental protocol (Table 2). From 1995 to 1997, experimental fisheries were conducted where all nets in a designated area were required to use pingers and only a sample of the nets were 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 1989-94, 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). Because of the Take Reduction Plan to reduce takes in USA Atlantic gillnets, and the NEFMC fishery management plans to manage groundfish, fishing practices changed during 1999. Subsequently, the average annual harbor porpoise mortality and serious injury in the Northeast sink gillnet fishery from 1999 to 2001 was 277 (0.25).

Mid-Atlantic Coastal Gillnet

Before an observer program was in place, 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 coastal gillnet fishery by the NEFSC Fisheries Observer program. 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 the vessels operate right off the beach, some using drift nets and others using sink nets. During 1998, it was estimated that there were 302 full and part-time sink gillnet vessels and an undetermined number of drift gillnet vessels participating in this fishery. This is the number of unique vessels in the commercial landings database (Weighout) that reported catch from this fishery during 1998 from the states of Connecticut to North Carolina. This does not include a small percentage of records where the vessel number was missing. Twenty trips were observed during 1993. During 1994 and 1995, 221 and 382 trips were observed, respectively. Observer coverage, expressed as percent of tons of fish landed, was 5% for 1995, 4% for 1996, 3% for 1997, 5% for 1998, 2% for 1999, 2% for 2000 and 2% for 2001 (Table 2). No harbor porpoises were taken in observed trips during 1993 and 1994. During 1995 to 2001, respectively, 6, 19, 32, 53, 3, 1 and 1 harbor porpoises were observed taken (Table 2). Observed fishing effort has been scattered between New York and North Carolina from the beach to 50 miles off the beach. Documented bycatches after 1995 were from December to May. Bycatch estimates were calculated using methods similar to that used for bycatch estimates in the Northeast gillnet fishery (Bravington and Bisack 1996; Bisack 1997a). 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. Annual average estimated harbor porpoise mortality and serious injury from the mid-Atlantic coastal gillnet fishery before the Take Reduction Plan (during 1995 to 1998) was 358 (CV=0.20) (Table 2). Because of the Take Reduction Plan to reduce takes in USA Atlantic gillnets, and the fishery management plans to manage groundfish, fishing practices changed during 1999. Subsequently, the average annual harbor porpoise mortality and serious injury in the mid-Atlantic coastal gillnet fishery from 1999 and 2001 was 33 (0.39).

Unknown Fishery

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported 228, 27 and 113 stranded harbor porpoises during 1999 to 2001, respectively (see Other Mortality section for more details). Of these, it was determined that the cause of death of 19, 1 and 3 stranded harbor porpoises in 1999 to 2001, respectively, were due to gillnets (Tables 3 and 5). The average harbor porpoise mortality and serious injury in this unknown fishery category from 1999 to 2001 is 8 (CV is unknown).

North Atlantic Bottom Trawl

Two harbor porpoise mortalities were observed in the North Atlantic bottom trawl fishery between 1989 and 2001. Vessels in this fishery, a Category III fishery under the MMPA, were observed in order to meet fishery management needs rather than marine mammal management needs. An average of 970 (CV=0.04) vessels (full- and part-time) participated annually in the fishery during 1989-1993. This fishery is active in New England waters in all seasons.

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.

In conclusion, the estimated bycatch of harbor porpoises due to this fishery is 0.

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 during 1997, 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.

During 1998, the number of fishing vessels was appreciably lower than in previous years due to very poor groundfish catch rates, even though the fishery was open July to September. The observer program monitored 111 trips and observed 5 harbor porpoise mortalities. Preliminary analyses indicate that the total mortality estimate is 38 harbor porpoises (Trippel and Shepard, in press). Estimates of variance are not available ().

During 1999, observer coverage was from July to early September. The observer program monitored 93 trips and observed 3 harbor porpoise mortalities. Preliminary analyses indicate the total mortality estimate is 32 harbor porpoises (Trippel and Shepard, in press)

During 2000, 194 trips were monitored and 5 harbor porpoise mortalities were observed. Preliminary analyses indicate that the total mortality estimate is 28 harbor porpoises (Trippel and Shepard, in press).

During 2001, 285 trips were monitored and 39 harbor porpoise mortalities were observed. Preliminary analyses indicate that the total mortality is 73 harbor porpoises (Trippel and Shepard, in press).

There was no observer program during the summer of 2002 in the Bay of Fundy region.

Average estimated harbor porpoise mortality in the Canadian groundfish sink gillnet fishery during 1997-2001 was 242 (Table 2). An estimate of variance is not possible.

Herring Weirs

Harbor porpoises are taken frequently in Canadian herring weirs, but there have been no recent efforts to observe takes in the USA component of this fishery. Weirs operate from May to October along the southwestern shore of the Bay of Fundy, and the coasts of western Nova Scotia and northern Maine. In 1990, there were 180 active weirs in the western Bay of Fundy and 56 active weirs in Maine (Read 1994). According to state officials, in 1998, the number of weirs in Maine waters dropped to nearly zero due to the limited herring market (Jean Chenoweth, pers. comm.), and in 2000, only 11 weirs were built (Molyneaux 2000). According to Canadian officials, for 1998, there were 225 licenses for herring weirs on the New Brunswick side and 30 from the Nova Scotia side of the Bay of Fundy (in New Brunswick: 60 from Grand Manan Island, 95 from Deer and Campobello Islands, 30 from Passamaquoddy Bay, 35 from East Charlotte area, and 5 from the Saint John area).

The number of licenses has been fairly consistent since 1985 (Ed Trippel, pers. comm.), but the number of active weirs is less than the number of licenses, and has been
decreasing every year, primarily due to competition with salmon mariculture sites (A. Read, pers. comm.). In 2001, there were 25 active weirs around Grand Manan (H. Koopman pers. comm), numbers for the Nova Scotia shore,

Campobello, Deer and the Wolves Islands, or the New Brunswick mainland shore are unknown. In 2002 there were 21 active weirs around Grand Manan (H. Koopman pers. comm).

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 488 harbor porpoises have been documented in Canadian herring weirs, of which 460 were released or escaped and 28 died. Mortalities (and releases) 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), and 14 (and 244) in 2001 (H. Koopman, pers. comm.). In addition, it is known that in 2001, an additional fifty-two animals swam out of weirs on their own (H. Koopman, 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 and 13 from 2002 (H. Koopman, pers. comm).

Average estimated harbor porpoise mortality in the Canadian herring weir fishery during 1997-2001 was 4.2 (Table 2). An estimate of variance is not possible.

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 [1]	Observer Coverage [2]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
				USA				
Northeast Sink Gillnet	Before TRP[6] 94-98	1993=349 1998=301	Obs. Data Weighout, Trip Logbook	.07, .05, .04, .06, .05	99[3], 43[3], 52[3], 47[3], 12[3]	2100[3], 1400[3], 1200[3], 782[3], 332[3]	.18, .27, .25, .22, .46	1163 (0.11)
	After TRP[6] 99-01	NA	Obs. Data, Weighout, Trip Logbook	.06, .06, .04	14[3],15[3], 4[3,8]	270[3], 507[3], 53[3,8]	.28, .37, .97	277 (0.25)
mid-Atlantic Coastal Gillnet	Before TRP[6] 95-98[4]	1998=302[7]	Obs. Data Weighout	.05, .04, .03, .05,	6, 19, 32, 53	103, 311, 572, 446	.57, .31, .35, .36	358 (0.20)
	After TRP[6] 99-01	NA	Obs. Data Weighout	.02, .02, .02	3, 1, 1	53, 21, 26	.49, .76, .95	33 (0.39)
USA TOTAL				1999-2001 only				(0.23)
				CANADA				
Groundfish Sink Gillnet	97-01			.8, .4, .36, .77,NA	19, 5, 3, ,5, 39	43, 38, 32[7], 28[9], 73	NA	42 (NA)
Herring Weir	97-01	1998=255 licenses[5]	Coop. Data	NA	2, 2, 3, 0, 14	2, 2, 3, 0, 14	NA	4.2 (NA)
CANADIAN TOTAL				1997 - 2001				46 (NA)
GRAND TOTAL								356 (NA)

NA = Not available.

[1] Observer data (Obs. Data) are used to measure bycatch rates; the USA data are collected by the Northeast Fisheries Science Center (NEFSC) Fisheries Observer 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 USA 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 trip logbook (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).

[2] The observer coverage for the USA and Canadian sink gillnet fishery is measured in trips, and for the mid-Atlantic coastal gillnet fishery, the unit of effort is tons of fish landed.

[3] Harbor porpoise taken before 1997 in observed pinger trips were added directly to the estimated total bycatch for that year. During 1997, harbor porpoises were taken on non-pingered scientific experimental strings within a time/area stratum that required pingers; during 1998, harbor porpoises were taken on a pingered string within a stratum that did not require pingers; during 2000, a harbor porpoise was taken on a non-pingered string within a stratum that did not require pingers but that stratum had other trips where strings with pingers were observed; and during 1999-2001, 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, and 2 observed harbor porpoise takes on pinger trips from 1992 to 2001, respectively, that are included in the observed mortality column. In addition, there were 9, 0, 2, 1,1, 4, and 0 observed harbor porpoise takes in 1995 to 2001, respectively, on trips dedicated to fish sampling versus dedicated to watching for marine mammals; these are included in the observed mortality column (Bisack 1997a).

[4] Only data after 1994 are reported because the observed coverages during 1993 and 1994 were negligible during the times of the year when harbor porpoise takes were possible.

[5] There were 255 licenses for herring weirs in the Canadian Bay of Fundy region.

[6] Effective 01 January 1999, a take reduction plan (TRP) was put into place to reduce bycatch of harbor porpoises in gillnets. See the section “USA Management Measures Taken to Reduce Bycatch” for more details.

[7] Sink gillnet vessels only. Number of drift gillnet vessels presently undetermined.

[8] During 2001 in the US 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 Jeffrey’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.

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 [1]	Assigned Mortality	Mean Annual Mortality
Unknown gillnet fishery	99-01	NA	Entanglement & Strandings	19, 1, 3	8
TOTAL					8

NA=Not Available.

[1] 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).

Other Mortality
USA

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 USA 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 beaches from North Carolina to Maine during 1994 to 2001 were 106, 86, 94, 118, 59, 228, 27 and 113 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 coastal gill net 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 (Table 5). 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 (Table 3). 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 (Table 5).

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 (Tables 3 and 5). 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 (Table 5).

During 2001, 113 harbor porpoises were reported stranded, of these most came from Massachusetts (39), Virginia (28), and North Carolina (21). Thirteen of these stranding displayed signs of fishery interactions, of these 3 animals were in an area and time that were not part of a bycatch estimate derived from the observer data (Tables 3 and 5).

Averaging 1999 to 2001, there was 1 animal per year that was stranded and mutilated and so cause of death was attributed to an unknown human-caused mortality (Table 5).

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals which 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. Summary of number of stranded harbor porpoises during January 1, 1994 to December 31, 2001, by state and year.

State	Year								Total
	1994	1995	1996	1997	1998	1999	2000	2001	
Maine	0	0	5	6	5	3	2	4	25
New Hampshire	0	0	2	0	0	0	0	0	2
Massachusetts[1,3]	9	26	31	28	18	60	8	39	219
								1	9
Connecticut	0	0	1	0	0	0	0	0	1
New York[4]	7	6	3	10	5	10	2	7	50
New Jersey[2]	17	18	12	21	16	23	2	6	115
Delaware	3	5	4	4	7	9	1	3	36
Maryland	10	4	3	10	1	21	3	4	56
Virginia	42	18	20	12	3	40	3	28	166
North Carolina	15	9	12	26	4	59	6	21	152
TOTAL	103	86	93	118	59	228	27	113	831

1 During 1996 three animals stranded alive on a Massachusetts beach. They were tagged and released.
2 Two of the porpoises that stranded on a New Jersey beach in 1998 had been previously tagged and released from an observed mid-Atlantic coastal gill net fishing vessel.
3 Five animals stranded alive in 1999 and were tagged and released.
4 One animal stranded alive in 1999, rehabilitated at Mystic Aquarium and died at the aquarium in April 2000.

Table 5. Cause of mortality of USA stranded harbor porpoises during January 1, 1999 to December 31, 2001. "Unique FI" is a fishery interaction that is in a time and area that could not be part of the mortality estimate derived from the observer program. "Not unique FI" is a fishery interaction that was in a time and area that may be part of the observer program derived mortality estimate. "No FI" is the cause of death was determined not to be related to a fishery interaction. "Alive" is stranded animal not dead. "CBD/Unk" is could not be determined or unknown cause of death.

Year	Unique FI[1]	Mutilation[2]	Not unique FI	No FI	Emaciated	CBD/Unk	Alive	Total
1999	19	1	19	41	30	112	6	228
2000	1	1	0	2	0	22	0	26
2001	3	1	10	32	0	64	3	113
Avg 99-01	8	1	11	25	10	66	3	122

1 Attributed to an unknown gillnet fishery.
2 Attributed to an unknown human-caused mortality.

CANADA

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

USA Management Measures Taken to Reduce Bycatch

A ruling to reduce harbor porpoise bycatch in USA Atlantic gill nets was published in the Federal Register (63 FR 66464) on 01 December 1998 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 area 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 using pingers must attend training and certification sessions on the use of the technology. The mid-Atlantic portion of the plan pertains to waters west of 72° 30' 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 specifications.

STATUS OF STOCK

The status of harbor porpoises, relative to OSP, in the US 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 (50 CFR Part 233). There are insufficient data to determine population trends for this species. 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 average annual fishery-related mortality and serious injury has not exceeded PBR for the last three years.

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