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

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the western North Atlantic, humpback whales feed during spring, summer and fall over a range which encompasses the eastern coast of the United States (including the Gulf of Maine), the Gulf of St Lawrence, Newfoundland/Labrador, and western Greenland (Katona and Beard 1990). Other North Atlantic feeding grounds occur off Iceland and northern Norway, including off Bear Island and Jan Mayen (Christensen *et al.* 1992; Palsbøll *et al.*, 1997). These six regions represent relatively discrete subpopulations, fidelity to which is determined matrilineally (Clapham and Mayo 1987). Genetic analysis of mitochondrial DNA (mtDNA) has indicated that this fidelity has persisted over an evolutionary timescale in at least the Icelandic and Norwegian feeding grounds (Palsbøll *et al.* 1995, Larsen *et al.* 1996).

Previously, the North Atlantic humpback whale population was treated as a single stock for management purposes (Waring *et al.* 1999). Indeed, earlier genetic analyses (Palsbøll *et al.* 1995), based upon relatively small sample sizes, had failed to discriminate among the four western North Atlantic feeding areas. However, genetic analyses often reflect a timescale of thousands of years, well beyond those commonly used by managers. Accordingly, the decision was recently made to reclassify the Gulf of Maine as a separate feeding stock; this was based upon the strong fidelity by individual whales to this region, and the attendant assumption that, were this subpopulation wiped out, repopulation by immigration from adjacent areas would not occur on any reasonable management timescale. This reclassification has subsequently been supported by new genetic analysis based upon a much larger collection of samples than those utilized by Palsbøll *et al.* (1995). These analyses have found significant differences in mtDNA haplotype frequencies of the four western feeding areas, including the Gulf of Maine (Palsbøll *et al.* in prep.)

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

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

A key question with regard to humpback whales off the southeastern and mid-Atlantic states is their population identity. Given the relative proximity of this region to the Gulf of Maine, a working hypothesis would be that these whales belong to a single population that ranges from the southeastern USA to Nova Scotia. However, a determination of their stock identity awaits the completion of an ongoing project (funded by NMFS in 1999) to collect and compare photographs and tissue samples from this region. This work is expected to be completed in 2000, at which time this portion of the Stock Assessment Report will be revised as necessary.

Feeding is the principal activity of humpback whales in New England waters, and their distribution in New England waters has been largely correlated to prey species and abundance, although behavior and bottom topography are factors in foraging strategy (Payne *et al.* 1986, 1990). Humpback whales are frequently piscivorous when in these waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes* spp.), and other small fishes. In the northern Gulf of Maine, euphausiids are also frequently taken (Paquet *et al.* 1997). Commercial depletion of herring and mackerel led to an increase in sand lance in the southwestern Gulf of Maine in the mid 1970s with a concurrent decrease in humpback whale abundance in the northern Gulf of Maine. Humpback whales were densest over the sandy shoals in the southwestern Gulf of Maine favored by the sand lance during much of the late 1970s and early 1980s, and humpback distribution appeared to have shifted to this area (Payne *et al.* 1986). An apparent reversal began in the mid 1980s, and herring and mackerel increased as sand lance again decreased (Fogarty *et al.* 1991). Humpback whale abundance in the northern Gulf of Maine increased dramatically during 1992-93 , along with a major influx of herring (P. Stevick, pers. comm.). Humpback whales were few in nearshore Massachusetts waters in the 1992-93 summer seasons. They were more abundant in the offshore waters of Cultivator Shoal and the Northeast Peak on Georges Bank, and on Jeffreys Ledge; these latter areas are more traditional locations of herring occurrence. In 1996 and 1997, sand lance, and thus humpback whales, were once again abundant in the Stellwagen Bank area. However, unlike previous cycles, where an increase in sand lance corresponded to a decrease in herring, herring remained relatively abundant in the northern Gulf of Maine, and humpbacks correspondingly continued to occupy this portion of the habitat, where they also fed on euphausiids (unpublished data, Center for Coastal Studies and College of the Atlantic).

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

POPULATION SIZE

It is not possible to produce a reliable estimate of abundance for the Gulf of Maine humpback whale population at at this time. Available data are too limited in geographic scope to yield a precise estimate, and additional data from the northern Gulf of Maine and perhaps elsewhere are required. In addition, the issue of whether humpback whales on the Scotian Shelf are part of this stock must be resolved. Humpback whales are known to inhabit banks on the Scotian Shelf to the east of the Gulf of Maine, but the rate of exchange between these habitats and the Gulf region is presently unknown. Numerous humpback whales were individually identified in this region by NMFS large whale surveys in 1998 and 1999; comparison of these photos to the Gulf of Maine catalogue (to be completed in 2000) should resolve this issue. In the meantime, this report will again use the North Atlantic abundance estimate given below.

The overall North Atlantic population (including the Gulf of Maine) was recently estimated from genetic tagging data collected by the YONAH project in the breeding range at 4,894 males (95% c.i. 3,374-7,123) and 2,804 females (95% c.i. 1,776-4,463) (Palsbøll *et al.* 1997). Since the sex ratio in this population is known to be even (Palsbøll *et al.* 1997), the excess of males is presumed to be a result of sampling bias, lower rates of migration among females or sex-specific habitat partitioning in the West Indies; whatever the reason, the combined total is an underestimate of overall population size in this ocean. Photographic mark-recapture analyses from the YONAH project gave an ocean-basin-wide estimate of 10,600 (95% c.i. 9,300 to 12,100), and an additional genotype-based analysis yielded a similar but less precise estimate of 10,400 (95% c.i. 8,000 to 13,600) (Smith *et al.* 1999). The estimate of 10,600 (CV=0.067) is regarded as the best available estimate for the North Atlantic. In the northeastern North Atlantic, Øien (1990) estimated from sighting survey data that there were 1,100 humpback whales in the Barents Sea region.

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 North Atlantic humpback whales is 10,600 (CV=0.067, Smith *et al.* 1999). The minimum population estimate for this stock is 10,019 humpback whales (CV=0.067).

Table 1. Summary of abundance estimates for North Atlantic humpback whales. Period and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV). MR = Mark-recapture.

Month/Year	Area	Type	N_{best}	CV	Source
1979-90	N. Atlantic Ocean W and SW of Iceland	Photo MR	5,543	0.16	Katona *et al.* 1994
1992-93	N. Atlantic Ocean	Photo MR	10,600	0.067	Smith *et al.* 1999
1992-93	N. Atlantic Ocean	Genotype MR	10,400	0.138	Smith *et al.* 1999
1992-93	West Indies	Genotype MR	4,894 males 2,804 females	0.180 0.218	Palsbøll *et al.* 1997

Current Population Trend

As detailed below, current data strongly suggest that the Gulf of Maine humpback whale stock is steadily increasing in size. This is consistent with the trend in the North Atlantic population overall (Smith *et al.* 1999) although there are no other feeding-area-specific estimates.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Barlow and Clapham (1997) applied an interbirth interval model to photographic mark-recapture data and estimated the population growth rate of the Gulf of Maine humpback whale stock at 6.5% (CV=0.012). Maximum net productivity is unknown for this population, although a theoretical maximum for any humpback population can be calculated using known values for biological parameters (Brandão *et al.* 1999). For the Gulf of Maine, data supplied by Barlow and Clapham (1997) and Clapham *et al.* (1995) gives values of 0.96 for survival rate, 6y as mean age at first parturition, 0.5 as the proportion of females, and 0.42 for annual pregnancy rate. From this, a maximum population growth rate of 0.072 is obtained according to the method described by Brandão *et al.* (1999). This suggests that the observed rate of 6.5% (Barlow and Clapham 1997) is close to the maximum for this stock.

Current and maximum net productivity rates are unknown for the North Atlantic population overall. Katona and Beard (1990) suggest an annual rate of increase of 9%; however, the lower 95% confidence level was less than zero. The difference between the estimates of abundance calculated by Katona and Beard (1990) and by Smith *et al.* (1999) were interpreted by the latter as probably being due to population growth in the years between the two estimates. This assumed growth rate would be very similar to the growth rate of 6.5% calculated using an interbirth interval model for humpback whales in the Gulf of Maine (Barlow and Clapham 1997).

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 10,019 (based on an estimate of abundance of 10,400 with a CV of 0.067). The maximum productivity rate is 0.065 from Barlow and Clapham (1997). The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because this stock is listed as an endangered species under the Endangered Species Act (ESA). PBR for the North Atlantic humpback whale stock is 33 whales.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 1994 through 1998, the total estimated human-caused mortality and serious injury to humpback whales is estimated as 3.65 per year. This average is derived from three components: 1) the 1994-1998 observed fishery, 0.25; 2) additional fishery interaction records from USA waters, 2.4; and 3) vessel collisions from USA waters, 1.0. For the reasons described below, the additional records (from other than the observed fishery) cannot provide a quantitative estimate, but suggest that a number of additional serious injuries and mortalities do occur. Note that in past stock assessment reports, a six-year time frame was used to calculate the averages for additional fishery interactions and vessel collisions. A five-year period was used for this report to be consistent with the time frames used for calculating the averages for the observed fishery and for other species. It is also important to stress that serious injury determinations are made based upon the best available information at the time of writing; these determinations may change with the availability of new information. For the purposes of this report, discussion is primarily limited to those records considered confirmed human-caused mortalities or serious injuries.

To better assess human impacts (both vessel collision and net entanglement), and considering the number of decomposed and incompletely or unexamined animals in the records, there needs to be greater emphasis on the timely recovery of carcasses and complete necropsies. The literature and review of records described here suggest that there are significant human impacts beyond those recorded in the fishery observer data. For example, a study of entanglement-related scarring on the caudal peduncle of 134 individual humpback whales in the Gulf of Maine suggested that between 48% and 78% had experienced entanglements (Robbins and Mattila 1999). Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or necropsied) represent 'lost data', some of which may relate to human impacts.

In addition, we have limited the serious injury designation to only those reports that had substantial evidence that the injury, whether from entanglement or vessel collision, was likely to significantly impede the whale's locomotion or feeding in the immediate future. There was no forecasting of how the injury may affect the whale over a longer term, namely from infection or susceptibility to further injury, such as additional entanglement. This conservative approach likely underestimates serious injury rates. For these reasons, the human impacts listed in this report must be considered a minimum estimate.

One notable entanglement record was not included in the estimate. It involved a whale seen off Massachusetts on several occasions in June and July of 1998. The whale was initially seen severely entangled, but was largely freed of the gear by the Center for Coastal Studies' disentanglement team. Only one length of line remained, trailing from its mouth. The whale appeared in poor health at the time, and the line in the mouth indicates it may have injested some gear. Since the whale was largely disentangled, it was not considered a serious injury; however, future sightings of the whale, identified as "Putter", may allow an assessment of whether the entanglement still resulted in a serious injury. There was also one Canadian record of a whale seen entangled in the Bay of Fundy on 7/19/98. The whale was partially disentangled by researchers, but the effort was cut short by nightfall. The whale reportedly swam off with a "potentially life threatening" amount of gear still wrapped on its body.

Background

As with right whales, human impacts (vessel collisions and entanglements) are factors which may be slowing recovery of the humpback whale population. There is an average of four to six entanglements of humpback whales a year in waters of the southern Gulf of Maine and additional reports of vessel-collision scars (unpublished data, Center for Coastal Studies). In addition, of 20 dead humpback whales (principally in the mid-Atlantic, where decomposition state did not preclude examination for human impacts), Wiley *et al.* (1995) reported that six (30%) had major injuries possibly attributable to ship strikes, and five (25%) had injuries consistent with possible entanglement in fishing gear. One whale displayed scars that may have been caused by both ship strike and entanglement. Thus, 60% of the whale carcasses which were suitable for examination showed signs that anthropogenic factors may have contributed to, or been responsible for, their death. Wiley *et al.* (1995) further reported that all stranded animals were sexually immature, suggesting a winter or migratory segregation and/or that juvenile animals are more susceptible to human impacts. Humpback whale entanglements also occur in relatively high numbers in Canadian waters. Reports of collisions with fixed fishing gear set for groundfish around Newfoundland averaged 365 annually from 1979 to 1987 (range 174-813). An average of 50 humpback whale entanglements (range 26-66) were reported annually between 1979 and 1988, and 12 of 66 humpback whales that were entangled in 1988 died (Lien *et al.* 1988). Volgenau *et al.* (1995) also summarized existing data and concluded that in Newfoundland and Labrador, cod traps caused the most entanglements and entanglement mortalities (21%) of humpbacks between 1979 and 1992. They also reported that gillnets are the gear that has been the primary cause of entanglements and entanglement mortalities (20%) of humpbacks in the Gulf of Maine between 1975 and 1990.

Fishery-Related Serious Injuries and Mortalities

Two mortalities were observed in the pelagic drift gillnet fishery since 1989. In winter 1993, a juvenile humpback was observed entangled dead in a pelagic drift gillnet along the 200 m isobath northeast of Cape Hatteras; in early summer 1995, a humpback was entangled and dead in a pelagic drift gillnet on southwestern Georges Bank (see below).

Additional reports of mortality and serious injury relevant to comparison to PBR, as well as description of total human impacts, are contained in records maintained by the Northeast Regional Office/NMFS. A number of these records (11 entanglements involving lobster gear) from the 1990-94 period were used in the 1997 List of Fisheries classification (62 FR 33, Jan. 2, 1997). For this report, the records of dead, injured, and/or entangled humpbacks (either found stranded or at sea) for the period 1994 to 1998 were reviewed. More than half of these records were eliminated from further consideration due to an absence of any evidence of human impact or, in the case of an entangled whale, it was documented that the animal had become disentangled. Of the remaining records, there were three mortalities where fishery interaction was probable, and 9 records where serious injury attributable to fishery interaction was probable—for a total of 12 records in the five-year period (Table 3). While these records are not statistically quantifiable in the same way as the observed fishery records, they provide some indication of the frequency of entanglements.

Fishery Information

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras. Bycatch has been observed by NMFS Sea Samplers in the pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in the pelagic longline, pelagic pair trawl, or other fisheries monitored by NMFS.

In January 1997 (62 FR 33, Jan. 2, 1997), NMFS changed the classification of the Gulf of Maine and USA mid-Atlantic lobster pot fisheries from Category III to Category I based on examination of stranding and entanglement records of large whales from 1990 to 1994 (including 11 serious injuries or mortalities of humpback whales).

Pelagic Drift Gillnet

In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. The fishery was active 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). 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. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995 and 1996 were 233, 243, 232, 197, 164, and 149 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994 to 1998, there were 12, 11 10, 0, and 11 vessels, respectively, in the fishery (Table 2). Observer coverage, expressed as percent of sets, 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, no fishery in 1997, and 99% coverage during 1998 (Table 2). Observer coverage dropped during 1996 because some vessels were deemed too small or unsafe by the contractor that provided observer coverage to NMFS. 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 strata (Northridge 1996). Total annual bycatch after 1993 were estimated separately for each year by summing the observed caught with the product of the average bycatch per haul and number of unobserved hauls as recorded in SEFSC logbooks. Variances were estimated using bootstrap re-sampling techniques. Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 0 in 1994 (0), 1.0 in 1995 (0), 0 in 1996 (0), and 0 in 1998 (0). The total average annual estimated fishery-related mortality and serious injury in fisheries monitored by NMFS in 1994-1998 was 0.25 humpback whale (CV= 0) (Table 2).

Table 2. Summary of the incidental mortality of the humpback whale (*Megaptera novaeangliae*), 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
Pelagic Drift Gillnet	94-98	1994=12 1995=11 1996=10 1998=11	Obs. Data Logbook	.87, .99, .64, NA, .99	0, 1, 0, NA, 0	0, 1.0[3], 0, NA, 0	0, 0, 0, NA, 0	0.25 (0)
TOTAL								0.25 (0)

1 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. Mandatory logbook (Logbook) data are used to measure total effort, and the data are collected at the Southeast Fisheries Science Center (SEFSC).

2 The observer coverage and unit of effort for the pelagic drift gillnet fishery is a set.

3 One vessel was not observed and recorded 1 set in a 10 day trip in the SEFSC mandatory logbook. If you assume the vessel fished 1.4 sets per day as estimated from the 1995 SS data, the point estimate may increase by 0.08 animals. However, the SEFSC mandatory logbook data were taken at face value, and therefore it was assumed that 1 set was fished within this trip, and the point estimate would then increase by 0.01 animals.

Table 3. Summarized records of mortality and serious injury likely to result in mortality, North Atlantic humpback whales, January 1994 - December 1998. This listing includes only records related to USA commercial fisheries and/or ship strikes in USA waters. Causes of mortality or injury, assigned as primary or secondary, are based on records maintained by NMFS/NER and NMFS/SER.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
7/14/94	serious injury	unknown	15 mi SE of Cape Elizabeth, Maine (43° 23' 68° 59')		P	CG helicopter crew reported animal with gillnet wrapped around head and swimming at surface
2/28/95	mortality	unknown	Cape Hatteras, North Carolina (35° 17' 75° 31')		P	stranded dead with gear wrapped around tail region

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
5/26/95	serious injury	length (est.) = 10 m	Great South Channel (41° 16' 69° 20')		P	net and monofilament around tail region; whale anchored; mesh visible and gear trailing
6/4/95	mortality	8.9 m male	Virginia Beach, Virginia	P		floater off inlet; lacerations along peduncle, probable ship strike
1/30/96	serious injury	juvenile	Northern Edge of Georges Bank (42° 26' 67° 30')		P	gear wrapped on body, some gear removed
2/22/96	serious injury	length (est.) = 8 m	Florida Keys		P	heavy line extending around maximum girth, pinning both pectorals; grooves/healed scars on dorsal ridge and on leading edge of both pectorals; fairly emaciated; disentangled
4/2/96	mortality	7.2 m female	Cape Story, Virginia Beach, Virginia	P		fresh dead; fractured left mandible; emaciated
5/9/96	mortality	6.7 m female	mouth of Delaware Bay	P		propeller cuts behind blowhole, moderate decomposition; ship strike
7/18/96	serious injury	length (est.) = 10 m	25 mi S of Bar Harbor Maine (44° 01' 68° 00')		P	disentanglement unsuccessful; weighted gear wrapped around tail stock; whale swimming abnormally
7/28/96	serious injury	length (est.) = 10m	SW corner of Stellwagen Bank, MA		P	entanglement involved mouth or flipper and line over tail; recent entanglement; extent of trailing gear unknown

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
10/7/96	serious Injury	unknown	Great South Channel (41° 04' 69° 10')		P	gear wrapped around tail and trailing 30 m behind whale
10/18/96	serious injury	unknown	Great South Channel (41° 00' 69° 10')		P	Whale entangled in steel cable
11/3/96	mortality	8.4 m male	Carrituck, North Carolina	P		acute trauma to skull found by necropsy
12/10/97	mortality	9.0 m male	Beaufort Inlet, NC	P		massive hemorrhage consistent with forceful blunt trauma
3/4/98	mortality	8.6 m female	Ocracoke Island, NC (35° 12' 75° 40')		P	Coast Guard present when whale drowned entangled in croaker gillnet gear
8/23/98	serious injury	adult, sex unknown	Montauk Pt., NY (40° 36' 70° 43')		P	whale anchored by offshore lobster gear, struggling to breath; not relocated by Coast Guard search
11/5/98	mortality	8.9 m male	Nags Head, NC (35° 59' 75° 38')		P	Deep abrasions around tail stock with subdermal hemorrhaging

Table notes:

1. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was reported beached, entangled, or injured.
2. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (62 FR 33, Jan. 2, 1997) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.
3. Assigned cause based on best judgement of available data. Additional information may result in revisions.
4. Entanglements of juvenile whales may become more serious as the whale grows.
5. There is no overlap between tables 2 and 3 (the two records from the observed fishery are not included in Table 3).

Other Mortality

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

As reported by Wiley *et al.* (1995) injuries possibly attributable to ship strikes are more common and probably more serious than those from entanglements. In the NER/NMFS records examined, several contained notes about wounds or probable/possible vessel collision. Five of these records were mortalities resulting from the collision. One record, on 7 October 1993, involving a 33 ft sport-fishing vessel, resulted in a serious injury to the whale.

Another collision occurred on 8/2/98, involving a whale watch vessel. The whale was sighted after the collision with a large gash in its back, however the seriousness of the injury could not be assessed. The whale was reportedly breathing normally.

STATUS OF STOCK

Although the most recent estimates of abundance indicate continued population growth, the size of the humpback whale stock may be below OSP in the USA Atlantic EEZ. This is a strategic stock because the humpback whale is listed as an endangered species under the ESA. A Recovery Plan has been published and is in effect (NMFS 1991). There are insufficient data to reliably determine population trends for humpback whales in the North Atlantic overall. The annual rate of population increase was estimated at 9% (Katona and Beard 1990, but with a lower 95% confidence level less than zero), and for the Gulf of Maine at 6.5% by Barlow and Clapham (1997). The total level of human-caused mortality and serious injury is unknown, but current data indicate that it is significant. 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 a zero mortality and serious injury rate.

Disturbance by whalewatching may prove to be an important habitat issue in some areas of this population's range, notably the coastal waters of New England where the density of whalewatching traffic is seasonally high. No studies have been conducted to address this question, and its impact (if any) on habitat occupancy and reproductive success is unknown.

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