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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

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

Not all whales migrate to the West Indies every winter, and significant numbers of animals are found in mid- and high-latitude regions at this time (Clapham *et al.* 1993; Swingle *et al.* 1993). An increased number of sightings of humpback whales in the vicinity of the Chesapeake and Delaware Bays occurred in 1992 (Swingle *et al.* 1993). Wiley *et al.* (1995) reported 38 humpback whale strandings occurred during 1985-1992 in the U.S. mid-Atlantic and southeastern states. Humpback whale strandings increased, particularly along the Virginia and North Carolina

coasts, and most stranded animals were sexually immature; in addition, the small size of many of these whales strongly suggested that they had only recently separated from their mothers. Wiley *et al.* (1995) concluded that these areas were becoming an increasingly important habitat for juvenile humpback whales and that anthropogenic factors may negatively impact whales in this area. There have also been a number of wintertime humpback sightings in coastal waters of the southeastern U.S. (NMFS unpublished data; New England Aquarium unpublished data; Florida DEP unpublished data). Whether the increased sightings represent a distributional change, or are simply due to an increase in sighting effort and/or whale abundance, is unknown.

A key question with regard to humpback whales off the southeastern and mid-Atlantic states is their population identity. This topic was investigated using fluke photographs of living and dead whales observed in the region (Barco *et al.* 2002). In this study, photographs of 40 whales (live or dead) were of sufficient quality to be compared to catalogues from the Gulf of Maine (the closest feeding ground) and other areas in the North Atlantic. Of 21 live whales, 9 (42.9%) matched to the Gulf of Maine, 4 (19.0%) to Newfoundland and 1 (4.8%) to the Gulf of St Lawrence. Of 19 dead humpbacks, 6 (31.6%) were known Gulf of Maine whales. Although the population composition of the mid-Atlantic is apparently dominated by Gulf of Maine whales, lack of recent photographic effort in Newfoundland makes it likely that the observed match rates under-represent the true presence of Canadian whales in the region. Barco *et al.* (2002) suggested that the mid-Atlantic region primarily represents a supplemental winter feeding ground used by humpbacks for more than one purpose.

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

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

POPULATION SIZE

The overall North Atlantic population (including the Gulf of Maine) derived from genetic tagging data collected by the YONAH project on the breeding grounds, was estimated to be 4,894 males (95% CI=3,374-7,123) and 2,804 females (95% CI=1,776-4,463) (Palsbøll *et al.* 1997). Since the sex ratio in this population is known to be even (Palsbøll *et al.* 1997), the excess of males is presumed a result of sampling bias, lower rates of migration among females or sex-specific habitat partitioning in the West Indies; whatever the reason, the combined total is an underestimate of overall population size. Photographic mark-recapture analyses from the YONAH project gave an ocean-basin-wide estimate of 11,570 animals during 1992/1993 (CV=0.068, Stevick *et al.* 2003), and an additional genotype-based analysis yielded a similar but less precise estimate of 10,400 whales (95% CI=8,000 to 13,600) (Smith *et al.* 1999). The estimate of 11,570 individuals (CV=0.068) is regarded as the best available estimate for the North Atlantic, although because YONAH sampling was not spatially representative in the feeding grounds, this value is negatively biased. In the northeastern North Atlantic, Øien (2001) estimated from sighting survey data that there were 889 (CV=0.32) humpback whales in the Barents and Norwegian Seas region.

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

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

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

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for Gulf of Maine humpback whales is 902 (CV=0.41). The minimum population estimate for this stock is 647.

Table 1. Summary of abundance estimates for Gulf of Maine humpback whales.

Month/Year	Type	N	CV	Source
July/August 1999	Line transect, including a portion of the Scotian Shelf stratum	902	0.41	Palka 2000, Clapham *et al.* 2003

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

Clapham *et al.* (2003) updated the Barlow and Clapham (1997) analysis using data from the period 1992 to 2000. The population growth estimate was either 0% (for a calf survival rate of 0.51) or 4.0% (for a calf survival rate of 0.875). Although confidence limits are not available (because maturation parameters could not be estimated),

both estimates of population growth rate are outside the 95% confidence intervals of the previous estimate of 6.5% for the period 1979 to 1991 (Barlow and Clapham 1997). It is unclear whether this apparent decline is an artifact resulting from a shift in distribution; indeed, such a shift occurred during exactly the period (1992-1995) in which survival rates declined. It is possible that this shift resulted in calves born in those years imprinting on (and thus subsequently returning to) areas other than those in which intensive sampling occured. If the decline is real, it may be related to known high mortality among young-of-the-year whales in the waters of the U.S. mid-Atlantic states. However, calf survival appears to have increased since 1996, presumably accompanied by an increase in population growth.

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

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 647. The maximum productivity rate is the default value of 0.04. 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 Gulf of Maine humpback whale stock is 1.3 whales.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 2000 through 2004, the total estimated human-caused mortality and serious injury to the Gulf of Maine humpback whale stock is estimated as 3.0 animals per year (U.S. waters, 2.4; Canadian waters, 0.6). This average is derived from incidental fishery interaction records, 2.4 (U.S. waters, 1.8; Canadian waters, 0.6); and records of vessel collisions, 0.6 (U.S. waters, 0.6; Canadian waters, 0). Additional humpback mortalities and serious injuries occurred in the southeastern and mid-Atlantic states but could not be confirmed as involving members of the Gulf of Maine stock. These records represent an additional minimum annual average of 2.0 human-caused mortalities and serious injuries to humpbacks over the time period, of which 1.2 per year are attributable to incidental fishery interactions and 0.8 per year are attributable to vessel collisions.

Beginning with the 2001 Stock Assessment Report, Canadian records were incorporated into the mortality and serious injury rates, to reflect the effective range of this stock as described above. Records from the southeastern and mid-Atlantic states involving individuals that could not be identified as members of the Gulf of Maine stock were tallied separately. Conversely, records involving unidentified individuals reported between New York and the Bay of Fundy were assumed to be whales from the Gulf of Maine stock. 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 gear entanglement), and considering the number of decomposed and incompletely or unexamined animals in the records, there needs to be greater emphasis on the timely recovery of carcasses and complete necropsies. The literature and review of records described here suggest that there are significant human impacts beyond those recorded in the fishery observer data. For example, a study of entanglement-related scarring on the caudal peduncle of 134 individual humpback whales in the Gulf of Maine suggested that between 48% and 65% had experienced entanglements (Robbins and Mattila 2001). Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or no necropsy performed) represent 'lost data' some of which may relate to human impacts.

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

from additional entanglements or vessel collisions. For these reasons, the human impacts listed in this report represent a minimum estimate.

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 4 to 6 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). Of 20 dead humpback whales (principally in the mid-Atlantic, where decomposition did not preclude examination for human impacts), Wiley *et al.* (1995) reported that 6 (30%) had major injuries possibly attributable to ship strikes, and 5 (25%) had injuries consistent with possible entanglement in fishing gear. One whale displayed scars that may have been caused by both ship strike and entanglement. Thus, 60% of the whale carcasses suitable for examination showed signs that anthropogenic factors may have contributed to, or been responsible for, their death. Wiley *et al.* (1995) further reported that all stranded animals were sexually immature, suggesting a winter or migratory segregation and/or that juvenile animals are more susceptible to human impacts.

An updated analysis of humpback whale mortalities from the mid-Atlantic states region was produced by Barco *et al.* (2002). Between 1990 and 2000, there were 52 known humpback whale mortalities in the waters of the U.S. mid-Atlantic states. Inspection of length data from 48 of these whales (18 females, 22 males, and 8 of unknown sex) suggested that 39 (81.2%) were first-year animals, 7 (14.6%) were immature and 2 (4.2%) were adults. However, sighting histories of 5 of the dead whales indicate that some were small for their age, and histories of live whales further indicate that the population contains a greater percentage of mature animals than was suggested by the stranded sample.

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

Humpback whale entanglements also occur in relatively high numbers in Canadian waters. Reports of interactions with fixed fishing gear set for groundfish around Newfoundland averaged 365 annually from 1979 to 1987 (range 174-813). An average of 50 humpback whale entanglements (range 26-66) was reported annually between 1979 and 1988, and 12 of 66 humpback whales entangled in 1988 died (Lien *et al.* 1988). Volgenau *et al.* (1995) reported that in Newfoundland and Labrador, cod traps caused the most entanglements and entanglement mortalities (21%) of humpbacks between 1979 and 1992. They also reported that gillnets were the primary cause of entanglements and entanglement mortalities (20%) of humpbacks in the Gulf of Maine between 1975 and 1990.

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

Fishery-Related Serious Injuries and Mortalities

A description of Fisheries is provided in Appendix III. Two mortalities were observed in the pelagic drift gillnet fishery, one in 1993 and the other in 1995. In winter 1993, a juvenile humpback was observed entangled and dead in a pelagic drift gillnet along the 200m isobath northeast of Cape Hatteras. In early summer 1995, a humpback was entangled and dead in a pelagic drift gillnet on southwestern Georges Bank. Additional reports of mortality and serious injury relevant to comparison to PBR, as well as description of total human impacts, are contained in records maintained by NMFS. A number of these records (11 entanglements involving lobster pot/trap gear) from the 1990-1994 period were the basis to reclassify the lobster fishery (62 FR 33, Jan. 2, 1997).

For this report, the records of dead, injured, and/or entangled humpbacks (found either stranded or at sea) during the period 2000 through 2004 were reviewed. Out of 175 records, 159 were eliminated from further consideration due to an absence of any evidence of human impact or, in the case of an entangled whale, the animal had become disentangled (10 were disentangled in 2003 alone). Of the remaining records, the Gulf of Maine stock sustained 4 mortalities attributable to fishery interactions and 8 cases of serious injuries - 12 records in the five-year period (Table 2). In addition, 3 mortalities and 3 serious injuries were documented in the southeastern and mid-Atlantic states that involved fisheries interactions. At the time of this writing, no genetic results are available to identify which of these cases may have involved whales from the Gulf of Maine stock. While these records are not statistically quantifiable in the same way as observer fishery records, they provide some indication of the frequency of entanglements.

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic humpback whales, January 2000 - December 2004. Records from the Gulf of Maine humpback whale stock are indicated by an asterisk (*) following the date. Stock identification of the remaining records awaits genetic analysis results. These may identify additional Gulf of Maine whales.

Date[a]	Report Type[b]	Sex, age, ID length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
1/08/00	serious injury	9.9m estimated	30mi east Cape Lookout, NC		P	whale swam off with 600' of sea trout sink gillnet, a chain anchor and a high flyer in tow
8/04/00*	serious injury	10.7m estimated	Bay of Fundy, Canada		P	line wrapped on head with weighted trailing line giving tension, no gear recovered
9/06/00*	serious injury	<1 yr old, calf of "Giraffe"	8 nm north of Race Pt., Cape Cod, MA		P	single line wrapped across back; constriction will increase as whale grows, no gear recovered
10/14/00	serious injury	9.9m estimated	off Ocean City Inlet, MD		P	heavily entangled in line; constrictive--fresh wounds noted; no gear recovered
10/20/00*	serious injury	10 yr old male "Tribble"	Stellwagen Bank, MA		P	entangled in green poly line on multiple body parts; appears constrictive, no gear recovered
1/25/01	mortality	6.9m estimated	Avon, NC	P		extensive hemorrhaging along left thoracic, clean cut through center of vertebrae; ship strike
4/07/01	mortality	7.6m juvenile male	Emerald Isle, NC		P	entanglement around peduncle caused extensive edema, hemorrhaging, no gear recovered
4/08/01	mortality	7.9m juvenile male	Myrtle Beach, SC	S	P	pre-mortem evidence of chronic line entanglement; severe prop wounds, no gear recovered
4/09/01*	mortality	8.8m juvenile female "Inland"	offshore of Sandbridge, Virginia Beach		P	found anchored in sink gillnet croaker fishery gear; line wraps around rostrum had immobilized the whale
7/29/01*	mortality	8.5m juvenile female	floating south of Verrazano Bridge, NY	P		large laceration on left side of head, extensive fracturing of skull
10/01/01*	mortality	11.4m 3 yr old female "Pitfall"	Duxbury Beach, MA	P		massive fracturing to skull, focal bruising indicative of pre-mortem ship strike
2/08/02	mortality	8.4m juvenile female	off Cape Henry, VA	P		three large lacerations, hemorrhaging, broken bones

3/24/02	mortality	8.0m juvenile male	off Virginia Beach, VA		P	deep cuts on caudal peduncle and tail indicative of embedded line, no gear recovered
6/03/02*	mortality	9.9m	off Cape Elizabeth, ME		P	deep cuts on caudal peduncle indicative of embedded line, state water lobster fishery
6/17/02*	serious injury	10.2m estimated	Outside Sesuit Harbor, Dennis, Cape Cod, MA		P	fluke severely damaged by line, whale emaciated
8/01/02*	mortality	9.3m male	Long Island, NY	P		large hematoma posterior to blow holes
10/01/02*	mortality	7.5m female calf	Plymouth, MA		P	extensive line chaffing and bruising on carcass; no gear recovered
6/06/03	mortality	8.3m female	Chesapeake Bay mouth, VA	P		major trauma to right side of head, hematoma
7/09/03*	serious injury	calf of Shockwave	Bay of Fundy, Canada		P	constricting entanglement on a young whale, no gear recovered
7/12/03	serious injury	unknown	Oregon Inlet, NC		P	entangled in substantial amount of gear, no gear recovered
8/15/03*	mortality	7.3m (est)calf	Petit Manan Island, ME		P	floating offshore wrapped in line, gillnet gear recovered
8/16/03*	serious injury	unknown	5nm NNE of Race Point, Cape Cod, MA		P	poor body condition; line deeply embedded; gear recovered included sink gillnet, vessel anchoring system and surface buoy system and endline
8/18/03*	serious injury	unknown	17 nm east of Chatham, MA		P	extensive entanglement, no gear recovered
7/11/04*	serious injury	"Lucky" subadult	Briar Island, NS		P	entanglement likely to become constricting as whale grows; no gear recovered
10/03/04*	mortality	15m (est) unknown	Georges Bank		P	fresh carcass with entangling line and high flyer; no gear recovered
12/19/04	mortality	8.0m calf	Bethany Beach, DE	P		hematoma and skeletal fracturing

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Cole *et al.* 2005) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.

Other Mortality

Between November 1987 and January 1988, at least 14 humpback whales died after consuming Atlantic mackerel containing a dinoflagellate saxitoxin (Geraci *et al.* 1989). The whales subsequently stranded or were recovered in the vicinity of Cape Cod Bay and Nantucket Sound, and it is highly likely that other mortalities occurred during this event which went unrecorded. In July 2003, another Unusual Mortality Event was recorded in offshore waters when an estimated minimum of 12-15 humpback whales died in the vicinity of the Northeast Peak of Georges Bank. Preliminary tests of samples taken from some of these whales tested positive for domoic acid at low levels, but it is currently unknown what levels would affect the whales and therefore no definitive conclusions

can yet be drawn regarding the cause of this event or its effect on the status of the Gulf of Maine humpback whale population.

During the first six months of 1990, seven dead juvenile (7.6 to 9.1 m long) humpback whales population is currently unknown stranded between North Carolina and New Jersey. The significance of these strandings is unknown, but is a cause for concern.

As reported by Wiley *et al.* (1995), injuries possibly attributable to ship strikes are more common and probably more serious than those from entanglements. In the NMFS records for 2000 through 2004, 10 records had some evidence of a collision with a vessel. Of these, 7 were mortalities as a result of the collision, and 2 did not have sufficient information to confirm the collision as the cause of death. The remaining incident occurred on 10/4/01 and involved a whale-watch vessel. Photos taken at the time of the collision confirmed that the injury was minor and follow-up documentation provided evidence that the injury had healed. Three of 7 cases of mortality from a vessel collision involved whales identified as members of the Gulf of Maine stock (7/29/01, 10/1/01 and 8/1/02; see Table 2).

STATUS OF STOCK

The status of the North Atlantic humpback whale population was the topic of an International Whaling Commission Comprehensive Assessment in June 2001, and again in May 2002. These meetings conducted a detailed review of all aspects of the population (IWC 2002). Although recent estimates of abundance indicate continued population growth, the size of the humpback whale stock may be below OSP in the U.S. Atlantic EEZ. A Recovery Plan has been published and is in effect (NMFS 1991). There are insufficient data to reliably determine current population trends for humpback whales in the North Atlantic overall. The average annual rate of population increase was estimated at 3.1% (SE=0.005, Stevick *et al.* 2003). As noted above, an analysis of demographic parameters for the Gulf of Maine (Clapham *et al.* 2003) suggested a lower rate of increase than the 6.5% reported by Barlow and Clapham (1997), but results may have been confounded by distribution shifts. The total level of U.S. fishery-caused mortality and serious injury is unknown, but reported levels are more than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. In particular, the continued high level of mortality among humpback whales off the U.S. mid-Atlantic states (Barco *et al.* 2002) is a concern given that at least some of these animals are known to be from the Gulf of Maine population. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and because the North Atlantic humpback whale is an endangered species.

A new large-scale assessment called More of North Atlantic Humpbacks (MoNAH) project is currently underway. This two-year study will attempt to estimate abundance and refine knowledge of population structure with extensive sampling in the Gulf of Maine/Scotian Shelf region and on the primary wintering ground on Silver Bank; additional research will focus on the U.S. mid-Atlantic states. The work is intended to update the YONAH assessment of North Atlantic humpback whales in preparation for a possible status review under the Endangered Species Act.

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