HUMPBACK WHALE (*Megaptera novaeangliae*): North Atlantic 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). Recent 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). Genetic partitioning is not evident in the western North Atlantic, however; thus these four subpopulations (Gulf of Maine, Gulf of St Lawrence, Newfoundland/Labrador and western Greenland) are treated as a single stock in this report. However, given that fidelity to each feeding area is known to be high, it is possible that each of the four regions should be managed separately, an approach which requires further investigation.

In winter, whales from all six feeding areas 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.

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 piscivorus when in these waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes dubius*), 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) (Allen *et al.* 1993) 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

The North Atlantic population 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.

A population size of 294 humpback whales (CV=0.45) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). The estimate is based on an inverse variance weighted pooling of spring and summer data. An average of these seasons was chosen because the greatest proportion of the population off the northeast USA coast appeared in the study area during these seasons. This estimate includes a dive-time scale-up correction of 3.6 but was not corrected for g(0), the probability of detecting an animal group on the track line. This estimate clearly does not reflect the current true population size because of its high degree of uncertainty (e.g., large CV), and its age. Furthermore, it is considerably smaller than the size of the existing catalog of identified individuals in the Gulf of Maine, and it was estimated just after cessation of extensive foreign fishing operations in the 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
spring/summer 1978-82	Cape Hatteras, NC to Nova Scotia	Transect	294	0.45	CETAP 1982
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

The rates of growth cited below, together with recent estimates of abundance that are larger than previous figures, appear to indicate that the humpback whale population in the North Atlantic is increasing. It is not known whether this increase is ocean-wide in nature or confined to specific feeding grounds. An increasing trend is apparent in the Gulf of Maine (Barlow and Clapham 1997); by contrast, the population which summers off western Greenland appears small and is perhaps static (F. Larsen, pers. comm.)

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. 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).

Other life history parameters that could be used to estimate net productivity include the following: mean birth rate for identified humpbacks in the southwestern Gulf of Maine during 1979-87 was 8% (CV = 0.25), with no significant inter-annual differences; calving interval was 2.35 years (CV = 0.30); and the average age at attainment of sexual maturity for both males and females was five years (Clapham and Mayo 1990; Clapham 1992).

For purposes of this assessment, the maximum net productivity rate was set at 0.065, as calculated for the Gulf of Maine population by 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 32.6 whales.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 1993 through 1997, the total estimated human-caused mortality and serious injury to humpback whales is estimated as 4.4 per year. This average is derived from three components: 1) the 1993-1997 observed fishery, 0. 6; 2) additional fishery interaction records, 2.6; and 3) vessel collisions, 1.2. 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; these determinations may change with the availability of new information.

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 1993 to 1997 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 was one mortality where fishery interaction was probable, and 12 records where serious injury attributable to fishery interaction was probable—for a total of 13 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 are suggestive 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. By-catch 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.

Pelagic Drift Gillnet

The estimated total number of hauls in the Atlantic pelagic drift gillnet fishery increased from 714 in 1989 to 1144 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. In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine vessels participated in this fishery between 1989 and 1993. In 1994, 1995, and 1996 there were 12, 11, and 10 vessels, respectively, in the fishery (Table 2). Observer coverage (percent of sets observed) was 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. The greatest concentrations of effort were located 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 by-catch, from 1989 to 1993, were obtained using the aggregated catch rates, by strata (Northridge 1996). Estimates of the total annual bycatch for 1994, 1995, and 1996 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. Estimated annual mortality (CV in parentheses), extrapolated from fishery observer data, was 1.5 in 1993 (0.34), 0 in 1994 (0), 1.0 in 1995 (0), and 0 in 1996 (0). The total average annual estimated fishery-related mortality and serious injury in fisheries monitored by NMFS in 1993-1997 was 0.6 humpback whale (CV = 0.34) (Table 2).

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).

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 [1]	Data Type [2]	Observer Coverage [3]	Observed Mortality	Estimated Mortality [4]	Estimated CVs [4]	Mean Annual Mortality
Pelagic Drift Gillnet	93-97	1994=12 1995=11 1996=10	Obs. Data Logbook	.42, .87, .99, .64, NA	1, 0, 1, 0, NA	1.5, 0, 1.0[5], 0, NA	0.34, 0, 0, 0, NA	0.6 (0.34)
TOTAL								0.6 (0.34)

1 1994, 1995, and 1996 shown, other years not available on an annual basis.

2 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).

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

4 For 1993, pooled bycatch rates were used to estimate bycatch in months that had fishing effort but did not have observer coverage. This method is described in Northridge (1996). In 1994 and 1995, observer coverage increased substantially, and bycatch rates were not pooled for this period.

5 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 1993 - December 1997. This listing includes only records related to USA commercial fisheries and/or USA waters. Cause 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	Unknownu ncertain	
4/22/93	serious injury	age and sex unknown	4 mi SE of Province-town, Mass. (42E 01' 70E 06')		P		line around tail region and flukes, whale thin; unknown if gear trailing; same whale disentangled on 4/24/93??; thin and weak; healing around line
5/5/93	serious injury	age estimated 2-3 y.o.	NW part Stellwagen Bank (42E 26' 70E 27')		P		buoy warp wrapped around base of flipper; anchored and very fatigued; whale freed itself; unknown whether carrying gear
7/26/93	serious injury	unknown	30 mi SE of Bar Harbor, Maine (44E 00' 67E 38')		P		entangled; line wrapped around head and behind blowhole
8/8/93	serious injury	unknown	11 mi SE of Bar Harbor, Maine (44E 17' 68E 00')		P		net & buoys on head, dorsal fin, flippers; trailing gear; stressed behavior; cuts and blood reported, netting was removed, line remained on tail
10/7/93	serious injury	unknown	Atlantic City, New Jersey	P			boat collision with 33 ' sport fishing vessel; extent of injuries undetermined
7/14/94	serious injury	unknown	15 mi SE of Cape Elizabeth, Maine (43E 23' 68E 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 (35E 17' 75E 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	Unknownuncertain	
5/26/95	serious injury	length (est.) = 10 m	Great South Channel (41E 16' 69E 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 (42E 26' 67E 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 (44E 01' 68E 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	Unknownu ncertain	
10/7/96	serious Injury	unknown	Great South Channel (41E 04' 69E 10')		P		gear wrapped around tail and trailing 30 m behind whale
10/18/96	serious injury	unknown	Great South Channel (41E 00' 69E 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, North Carolina	P			massive hemorrhage consistent with forceful blunt trauma

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 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. 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 perhaps 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.

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 above suggest that there are significant human impacts beyond those in the fishery observer data. Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or necropsied) represent 'lost data', some of which may relate to human impacts. For these reasons, the human impacts listed in this report must be considered a minimum estimate.

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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