~~January~~December 2002

NORTH ATLANTIC RIGHT WHALE (*Eubalaena glacialis*): Western Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Individuals of the western North Atlantic right whale population range from wintering and calving grounds in coastal waters of the southeastern United States to summer feeding and nursery grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf. Knowlton *et al*. (1992) reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland; in addition, recent resightings of photographically identified individuals have been made off Iceland and arctic Norway. The latter (in September 1999) represents one of only two sightings this century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described. Similarly, records from the Gulf of Mexico (Moore and Clark 1963; Schmidly *et al*. 1972) represent either geographic anomalies or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern United States. Whatever the case, the location of a large segment of the population is unknown during the winter. Offshore surveys flown off the coast of northeastern Florida and southeastern Georgia from 1996 to 2001 had 3 sightings in 1996, 1 in 1997, 13 in 1998, 6 in 1999, 11 in 2000 and 6 in 2001 (within each year, some were repeat sightings of previously recorded individuals). The frequency with which right whales occur in offshore waters in the southeastern U.S. remains unclear.

Research results to date suggest the existence of 6 major habitats or congregation areas for western North Atlantic right whales; these are the coastal waters of the southeastern United States, the Great South Channel, Georges Bank/Gulf of Maine, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Scotian Shelf. However, movements within and between habitats may be more extensive than is sometimes thought. Results from satellite tags clearly indicate that sightings separated by perhaps two weeks should not necessarily be assumed to indicate a stationary or resident animal. Instead, telemetry data have shown rather lengthy and somewhat distant excursions, including into deep water off the continental shelf (Mate *et al*. 1997). These findings indicate that movements and habitat use are more complex than previously thought.

New England waters are a primary feeding habitat for the right whale, which appears to feed primarily on copepods (largely of the genera *Calanus* and *Pseudocalanus*) in this area. Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitats (Kenney *et al*. 1986, 1995). Acceptable surface copepod resources are limited to perhaps 3% of the region during the peak feeding season in Cape Cod and Massachusetts Bays (C. Mayo pers. comm.). While feeding in the coastal waters off Massachusetts has been better studied than in most areas, feeding by right whales has also been observed on the margins of Georges Bank, in the Gulf of Maine, in the Bay of Fundy, and over the Scotian Shelf. The characteristics of acceptable prey distribution in these areas are not well known. In addition, New England waters serve as a nursery for calves and perhaps also as a mating ground. NMFS and Center for Coastal Studies aerial surveys in the spring of 1999, 2000, 2001 and 200~~1~~2 found substantial numbers of right whales along the Northern Edge of Georges Bank, in Georges Basin, and in various locations in the Gulf of Maine including Cashes Ledge, Platts Bank and Wilkinson Basin. The predictability with which right whales occur in such locations remains unclear, and these new data highlight the need for more extensive surveys of habitats which have previously received minimal coverage.

Genetic analyses based upon direct sequencing of mitochondrial DNA (mtDNA) have identified five mtDNA haplotypes in the western North Atlantic population (Malik *et al.* 1999). Schaeff *et al.* (1997) compared the genetic variability of North Atlantic and southern right whales (*E. australis*), and found the former to be significantly less diverse, a finding broadly replicated from sequence data by Malik *et al*. (2000). These findings might be indicative of inbreeding in the population, but no definitive conclusion can be reached using current data. Additional work comparing modern and historic genetic population structure in right whales, using DNA extracted from museum and archaeological specimens of baleen and bone, is also underway (Rosenbaum *et al*. 1997, 2000). Preliminary results suggest that the eastern and western North Atlantic populations were not genetically distinct (Rosenbaum *et al*. 2000). However, the virtual extirpation of the eastern stock and its lack of recovery in the last hundred years strongly suggests population subdivision over a protracted (but not evolutionary) timescale. Results also suggest that, as expected, the principal loss of genetic diversity occurred during major exploitation events prior to the 20th century.

To date, skin biopsy sampling has resulted in the compilation of a DNA library of more than 280 North Atlantic right whales. When work is completed, a genetic profile will be established for each individual, and an assessment provided on the level of genetic variation in the population, the number of reproductively active individuals, reproductive fitness, the basis for associations and social units in each habitat area, and the mating system. Tissue analysis has also aided in sex identification: the sex ratio of the photo-identified and catalogued population does not differ significantly from parity (M.W. Brown, pers. comm.). Analyses based on both genetics and sighting histories of photographically identified individuals also suggest that approximately one-third of the population utilizes summer nursery grounds other than the Bay of Fundy. As described above, a related question is where individuals other than calving females and a few juveniles overwinter. One or more additional wintering and summering grounds may exist in unsurveyed locations, although it is also possible that "missing" animals simply disperse over a wide area at these times. Identification of such areas, and the possible threats to right whales there, is recognized as a priority for research efforts.

POPULATION SIZE

Based on a census of individual whales identified using photo-identification techniques, the western North Atlantic population size was estimated to be 295 individuals in 1992 (Knowlton *et al*. 1994); an updated analysis using the same method gave an estimate of 291 animals in 1998 (Kraus *et al*. 2001) Because this was a nearly complete census, it is assumed that this represents a minimum population size estimate. However, no estimate of abundance with an associated coefficient of variation has been calculated for this population. Calculation of a reliable point estimate is likely to be difficult given the known problem of heterogeneity of distribution in this population. An IWC workshop on status and trends of western North Atlantic right whales gave a minimum direct-count estimate of 263 right whales alive in 1996 and noted that the true population was unlikely to be substantially greater than this (Best *et al*. 2001).

Historical Abundance

An estimate of pre-exploitation population size is not available. Basque whalers may have taken substantial numbers of right whales at times during the 1500s in the Strait of Belle Isle region (Aguilar 1986), and the stock of right whales may have already been substantially reduced by the time whaling was begun by colonists in the Plymouth area in the 1600s (Reeves and Mitchell 1987). A modest but persistent whaling effort along the coast of the eastern USA lasted three centuries, and the records include one report of 29 whales killed in Cape Cod Bay in a single day during January 1700. Based on incomplete historical whaling data, Reeves and Mitchell (1987) could conclude only that there were at least some hundreds of right whales present in the western North Atlantic during the late 1600s. In a later study (Reeves *et al*. 1992), a series of population trajectories using historical data and an estimated present population size of 350 were plotted. The results suggest that there may have been at least 1,000 right whales in this population during the early to mid-1600s, with the greatest population decline occurring in the early 1700s. The authors cautioned, however, that the record of removals is incomplete, the results were preliminary, and refinements are required. Based on back calculations using the present population size and growth rate, the population may have numbered fewer than 100 individuals by the time international protection for right whales came into effect in 1935 (Hain 1975; Reeves *et al*. 1992; Kenney *et al*. 1995). However, too little is known about the population dynamics of right whales in the intervening years to state anything with confidence.

Minimum Population Estimate

The western North Atlantic population size was estimated to be 291 individuals in 1998 (Kraus *et al*. 2001), based on a census of individual whales identified using photo-identification techniques. A bias that might result from including catalogued whales that had not been seen for an extended period of time and therefore might be dead, was addressed by assuming that an individual whale not sighted for five or more years was dead (Knowlton *et* *al*. 1994). It is assumed that the census of identified and presumed living whales represents a minimum population size estimate. The true population size in 1998 may have been higher if: 1) there were animals not photographed and identified, and/or 2) some animals presumed dead were not.

Current Population Trend

The population growth rate reported for the period 1986-92 by Knowlton *et al*. (1994) was 2.5% (CV=0.12), suggesting that the stock was showing signs of slow recovery. However, work by Caswell *et al*. (1999) has suggested that crude survival probability declined from about 0.99 in the early 1980's to about 0.94 in the late 1990's. The decline was statistically significant. Additional work conducted in 1999 was reviewed by the IWC workshop on status and trends in this population (Best *et al*. 2001); the workshop concluded based on several analytical approaches that survival had indeed declined in the 1990's. Although heterogeneity of capture could negatively bias survival estimates, the workshop concluded that this factor could not account for all of the observed decline, which appeared to be particularly marked in adult females.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

During 1980-1992, 145 calves were born to 65 identified cows. The number of calves born annually ranged from 5 to 17, with a mean of 11.2 (SE=0.90). The reproductively active female pool was static at approximately 51 individuals during 1987-1992. Mean calving interval, based on 86 records, was 3.67 years. There was an indication that calving intervals may have been increasing over time, although the trend was not statistically significant (P=0.083) (Knowlton *et al*. 1994).

Since that report, total reported calf production in 92/93 was 6; 93/94, 9; 94/95, 7; 95/96, 21; 96/97, 20; 97/98, 6; 98/99, 4; ~~and~~ 99/~~20~~00, 1; 00/01, 31; and 01/02, 22. The total calf production was reduced by reported calf mortalities: 2 mortalities in 1993, 3 in 1996, 1 in 1997, ~~and~~ 1 in 1998, and 3 in 2001. Of the three calf mortalities in 1996, available data suggested one was not included in the reported 20 mother/calf pairs, resulting in a total of 21 calves born. Eleven of the 21 mothers in 1996 were observed with calves for the first time (*i.e.*, were "new" mothers) that year. Three of these were at least 10 years old, 2 were 9 years old, and 6 were of unknown age. An updated analysis of calving interval through the 1997/98 season suggests that mean calving interval increased since 1992 from 3.67 years to more than 5 years, a significant trend (Kraus *et al*. 2001). This conclusion is supported by modeling work reviewed by the IWC workshop on status and trends in this population (Best *et al*. 2001); the workshop agreed that calving intervals had indeed increased and further that the reproductive rate was approximately half that reported from studied populations of *E. australis*. The low calf production in subsequent years (4 in 1999 and only 1 in 2000) gives added cause for concern, although a record 31 calves were born in 2001. A workshop on possible causes of reproductive failure was held in April 2000 (Reeves *et al*. 2001). Factors considered included contaminants, biotoxins, nutrition/food limitation, disease and inbreeding problems. While no conclusions were reached, a research plan to further investigate this topic was developed.

The annual population growth rate during 1986-1992 was estimated to be 2.5% (CV=0.12) using photo-identification techniques (Knowlton *et al*. 1994). A population increase rate of 3.8% was estimated from the annual increase in aerial sighting rates in the Great South Channel, 1979-1989 (Kenney *et al*. 1995). However, as noted above, more recent work indicated that the population was in decline in the 1990's (Caswell *et al*. 1999, Best *et al*. 2001).

An analysis of the age structure of this population suggests that it contains a smaller proportion of juvenile whales than expected (Hamilton *et al*. 1998a; Best *et al*. 2001), which may reflect lowered recruitment and/or high juvenile mortality. In addition, it is possible that the apparently low reproductive rate is due in part to unstable age structure or to reproductive senescence on the part of some females. However, data on either factor are poor; senescence has been demonstrated in relatively few mammals (including humans, pilot whales and killer whales) and is currently undocumented for any baleen whale.

The relatively low population size indicates that this stock is well below its optimum sustainable population size (OSP); therefore, the current population growth rate should reflect the maximum net productivity rate for this stock. The population growth rate reported by Knowlton *et al*. (1994) of 2.5% (CV=0.12) was assumed to reflect the maximum net productivity rate for this stock for purposes of previous assessments. However, review by the IWC workshop of modeling and other work indicates that the population was in decline in the 1990's (Best *et al*. 2001); consequently, no growth rate can be used for western North Atlantic right whales.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is specified as the product of minimum population size, one-half the maximum net productivity rate and a "recovery" factor for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The recovery factor for right whales is 0.10 because this species is listed as endangered under the Endangered Species Act (ESA). However, in view of the population decline indicated by recent demographic analyses (Caswell *et al*. 1999, Best *et al*. 2001), the PBR for this population is set to zero.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 199~~6~~7 through 200~~0~~1, the total estimated human-caused mortality and serious injury to right whales is estimated at ~~1~~2.~~8~~0 per year (USA waters, 1.2; Canadian waters, 0.~~6~~8). This is derived from two components: 1) non-observed fishery entanglement records at 1.~~0~~2 per year (USA waters, 0.6 ; Canadian waters, 0.~~4~~6), and 2) ship strike records at 0.8 per year (USA waters, 0.6; Canadian waters, 0.2). Note that in the 1996 and 1998 stock assessment reports, a six-year time frame was used to calculate these averages. A five-year period has since been used to be consistent with the time frames used for calculating the averages for other species. Beginning with the 2001 Stock Assessment Report, Canadian records were incorporated into the mortality and serious injury rates of this report to reflect the effective range of this stock. 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. For the purposes of this report, discussion is primarily limited to those records considered confirmed human-caused mortalities or serious injuries.

Background

The details of a particular mortality or serious injury record often require a degree of interpretation. The assigned cause is based on the best judgement of the available data; additional information may result in revisions. When reviewing Table 1 below, several factors should be considered: 1) a ship strike or entanglement may occur at some distance from the reported location; 2) the mortality or injury may involve multiple factors; for example, whales that have been both ship struck and entangled are not uncommon; 3) the actual vessel or gear type/source is often uncertain; and 4) in entanglements, several types of gear may be involved.

The serious injury determinations are most susceptible to revision. There are several records where a struck and injured whale was re-sighted later, apparently healthy, or where an entangled or partially disentangled whale was re-sighted later free of gear. The reverse may also be true: a whale initially appearing in good condition after being struck or entangled is later re-sighted and found to have been seriously injured by the event. Entanglements of juvenile whales are typically considered serious injuries because the constriction on the animal is likely to become increasingly harmful as the whale grows.

We have limited the serious injury designation 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. Injuries that impeded the 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 may increase the whale's susceptibility to further injury, namely from additional entanglements or vessel collisions. This conservative approach likely underestimates serious injury rates.

With these caveats, the total estimated annual average human-induced mortality and serious injury incurred by this stock (including fishery and non-fishery related causes) was ~~1.8~~2.0 right whales per year (USA waters 1.2; Canadian waters, 0.~~6~~8). As with entanglements, some injury or mortality due to ship strikes almost certainly passes undetected, particularly in offshore waters. 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 figure of ~~1.8~~2.0 right whales per year must be regarded as a minimum estimate.

Further, the small population size and low annual reproductive rate suggest that human sources of mortality may have a greater effect relative to population growth rates than for other whales. The principal factors believed to be retarding growth and recovery of the population are ship strikes and entanglement with fishing gear. Between 1970 and 1999, a total of 45 right whale mortalities were recorded (IWC 1999; Knowlton and Kraus 2001). Of these, 13 (28.9%) were neonates which are believed to have died from perinatal complications or other natural causes. Of the remainder, 16 (35.6%) were determined to be the result of ship strikes, 3 (6.7%) were related to entanglement in fishing gear (in two cases lobster gear, and one gillnet gear), and 13 (28.9%) were of unknown cause. At a minimum, therefore, 41.3% of the observed total for the period, and 59.4% of the 32 non-calf deaths, were attributable to human impacts.

Young animals, ages 0-4 years, are apparently the most impacted portion of the population (Kraus 1990). Finally, entanglement or minor vessel collisions may not kill an animal directly, but may weaken or otherwise affect it so that it is more likely to become vulnerable to further injury. Such was apparently the case with the two-year--old right whale killed by a ship off Amelia Island, Florida, in March 1991 after having carried gillnet gear wrapped around its tail region since the previous summer (Kenney and Kraus 1993). A similar fate befell right whale #2220, found dead on Cape Cod in 1996.

For waters of the northeastern USA, a present concern not yet completely defined, is the possibility of habitat degradation in Massachusetts and Cape Cod Bays due to a Boston sewage outfall which came on-line in September 2000.

~~Awareness and mitigation programs for reducing anthropogenic injury and mortality to right whales have been set up in two areas of concern. The first was initiated in 1992 off the coastal waters of the southeastern USA, and it has been upgraded and expanded annually. It involves both government and non-government organizations, including the Navy, Army Corps of Engineers, U.S. Coast Guard, and Florida and Georgia state agencies. In 1996, a program was established in the northeastern USA, largely in cooperation with the U.S. Coast Guard and the State of Massachusetts. In July 1999, a Mandatory Ship Reporting System was implemented in both the southeastern United States and in the Great South Channel/Cape Cod Bay/Massachusetts Bay critical habitats. This system requires vessels over 300 tons to report information about their identity, location, course and speed; in return, they receive information on right whale occurrence and recommendations on measures to avoid collisions with whales. This system is providing much-needed information on patterns of vessel traffic in critical habitat areas.~~

Fishery-Related Serious Injury and Mortality

Reports of mortality and serious injury relative to PBR as well as total human impacts are contained in records maintained by the New England Aquarium and the NMFS Northeast and Southeast Regional Offices (Table 1). From 199~~6~~7 through 200~~0~~1, ~~5~~6 of ~~9~~10 records of mortality or serious injury (including records from both USA and Canadian waters) involved entanglement or fishery interactions. The reports often do not contain the detail necessary to assign the entanglements to a particular fishery or location. However, based on re-examination of the records for the right whale observed entangled in pelagic drift gillnet in July 1993, which included the observer's documentation of lobster gear on the whale's tail stock, and subsequent entanglement reports of this whale, the suspected mortality of this whale was reassigned to the Gulf of Maine and USA mid-Atlantic lobster pot fisheries. In this case, the pre-existing entanglement of lobster gear was judged to have been sufficient cause of eventual mortality independent of the drift net entanglement. In another instance, a ~~2 year-old~~two-year-old dead male right whale with lobster line through the mouth and deeply embedded at the base of the right flipper beached in Rhode Island in July 1995. This individual had been sighted previously, entangled, east of Georgia in December 1993, and again in August 1994 in Cape Cod Bay. In this case, the entanglement became a serious injury and (directly or indirectly) the cause of the mortality.

~~D~~Although disentanglement is either unsuccessful or not possible for the majority of cases, during the period 199~~6~~7 through 200~~0~~1, there were at least ~~four~~five documented cases of entanglements for which the intervention of disentanglement teams averted a likely serious injury determination. On 6/5/~~19~~99, a two--year--old female, #2753, was found with a line through the mouth and trailing a ~~n~~Norwegian ball and highflyer. The nature of the entanglement would likely not have allowed the whale to shed the gear, and over a prolonged period, the rope's ~~chaffing~~chafing likely would have ~~likely~~ caused systemic infection. Another two--year--old female, #2710, was sighted on 7/21/1999 wrapped in Canadian pot gear. A line passed through the mouth and around at least the right flipper. This entanglement would have become more constrictive as the whale grew. On 7/9/00, #2746, a three--year--old of unknown gender~~,~~ was seen with a line running through either side of the mouth and bridled behind the blowholes, while another portion of the line pinned the left flipper to the whale's flank. A nine--year--old female, #2223, was sighted on 8/18/00 with line tightly wrapped across her back, running through the mouth, and possibly wrapped on the left flipper. Subsequent sightings prior to the disentanglement revealed that the line across the back was beginning to tighten. On 7/20/01, #2427, a seven-year-old male was sighted off Portsmouth, New Hampshire, with line wrapped tightly around the rostrum and through the mouth. The whale was disentangled later that day, and subsequent resightings indicated that the injuries were healing. However, observers also noted that the whale's baleen was damaged, and that the whale was holding its head high out of the water and not diving nearly as frequently as other whales in the area. Its swimming and diving behavior was still unusual during the most recent resighting we have on record.

In January 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 (62 FR 33, Jan. 2, 1997).

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 since that year, several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks), and currently provides observer coverage of vessels fishing south of Cape Hatteras. Bycatch of a right whale has been observed by NMFS Sea Samplers in the pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in ~~either~~any of the ~~pelagic longline, pelagic pair trawl, or~~ other fisheries monitored by NMFS. The only bycatch of a right whale documented by NMFS Sea Samplers was a female released from a pelagic drift gillnet in 1993, as noted above.

In a recent analysis of the scarification of right whales, a total of 61.6% of the whales bore evidence of entanglements with fishing gear (Hamilton *et al*. 1998b). Further research using the North Atlantic Right Whale Catalogue has indicated that, each year, between 10% and 28% of right whales are involved in entanglements (Knowlton *et al*. 2001). Entanglement records maintained by NMFS Northeast Regional Office (NMFS, unpublished data) from 1970 through 2000 included at least 72 right whale entanglements or possible entanglements, including right whales in weirs, entangled in gillnets, and trailing line and buoys. An additional record (M. J. Harris, pers. comm.) reported a 9.1-10.6 m right whale entangled and released south of Ft. Pierce, Florida, in March 1982 (this event occurred during a sampling program and was not related to a commercial fishery). Incidents of entanglements in groundfish gillnet gear, cod traps, and herring weirs in waters of Atlantic Canada and the USA east coast were summarized by Read (1994). In six records of right whales becoming entangled in groundfish gillnet gear in the Bay of Fundy and Gulf of Maine between 1975 and 1990, the right whales were either released or escaped on their own, although several whales have been observed carrying net or line fragments. A right whale mother and calf were released alive from a herring weir in the Bay of Fundy in 1976. For all areas, specific details of right whale entanglement in fishing gear are often lacking. When direct or indirect mortality occurs, some carcasses come ashore and are subsequently examined, or are reported as "floaters" at sea; however, the number of unreported and unexamined carcasses is unknown, but may be significant in the case of floaters. More information is needed about fisheries interactions and where they occur.

Other Mortality

Ship strikes are a major cause of mortality and injury to right whales (Kraus 1990; Knowlton and Kraus 2001). Records from 199~~6~~7 through 200~~0~~1 have been summarized in Table 1. For this time frame, the average reported mortality and serious injury to right whales due to ship strikes was 0.8 whales per year (USA waters, 0.6; Canadian waters, 0.2).

In the period January to March 1996, an 'unusual mortality event' was declared for right whales in southeastern USA waters. Five mortalities were reported, at least one of which (on 1/30/96) was attributable to ship strike. A second mortality (on 2/22/96) showed evidence of barotrauma but no proximate cause of death could be determined. Of the remaining three mortalities, two were calves (~~½/96~~1/2/96 and 2/19/96), one of which may have died from birthing trauma (inconclusive). The third (2/7/96) was decomposed and could not be towed in for examination. In 2000, two right whales were sighted in the Bay of Fundy with large open wounds that were likely the result of collisions with vessels. Right whale #2820, a male of unknown age, was first seen injured on 7/9/00. He was sighted intermittently throughout the remainder of that summer, and was seen again in the Bay of

Fundy in 2001. The second whale, #2660, is a five--year--old female who was sighted with a wound on the left side of her head, just forward of the blowholes. She has not been resighted since. Although both of these injuries have a gruesome appearance, in the absence of a chronic stressor (i.e., ~~line~~entangling fishing gear), they are not likely to ~~fatal. In 2001, a total of five right whale mortalities were reported. One of these carcasses had indications of a collision with a vessel. In addition, four entanglements were reported in 2001. In 2002, two~~be fatal.

In 2002, six mortalities and ~~four~~8 entanglements had been reported at the time of this writing. A comprehensive review of all available information pertaining to these reports has not been completed, and therefore determinations of the total levels of anthropogenic mortality and serious injury for these years have yet to be done.

Table 1. Summarized records of mortality and serious injury likely to result in mortality, North Atlantic right whales, January 199~~6~~7 through December 200~~0~~1. Causes of mortality or injury, assigned as primary or secondary, are based on records maintained by ~~NMFS/NER and NMFS/SER~~NMFS.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh inter	
~~1/30/96~~	~~mortality, offshore~~	~~adult male, #1623~~	~~offshore GA~~	~~P~~		~~shattered skull, broken vertebrae and ribs~~
~~3/9/96~~	~~mortality, beached~~	~~male, age unknown #2220~~	~~Cape Cod MA~~	~~P~~	~~S~~	~~3.3 meter gash on back, broken skull, Canadian lobster gear wrapped through mouth and around tail~~
~~8/5/96~~	~~serious injury~~	~~unknown~~	~~SE of Gloucester, MA~~		~~P~~	~~unknown type of gear entangled around head~~
8/19/97	mortality	female, age unknown #2450	Bay of Fundy	P		necropsy found evidence of traumatic impact on left side and lower jaw
8/23/97	serious injury	5 y.r o.ld male #2212	Bay of Fundy		P	reports from subsequent observations indicate the whale ingested some gear of an unknown type
8/29/97	serious injury	2 yr old female #2557	Bay of Fundy Canada		P	Line of unknown origin tightly wrapped on body and one flipper, whale emaciated
4/20/99	mortality	27+ yr. old female, #1014	Cape Cod, MA	P		Fractures to mandible and vertebral column, abrasion and edema around right flipper

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh inter	
5/10/99	mortality, offshore	adult female, #2030	80mi east of Cape Cod, MA		P	Constricting sink gillnet gear created deep, extensive lacerations
3/01/00	serious injury	adult male, #1130	6mi east of Manomet, MA		P	Line apparently constricting left flipper; flipper discolored; abnormal cyamid distribution; bullet buoy trailing, line weighted down between whale and buoy
3/17/01	mortality	male calf	Assateague, VA	P		Large fresh propeller gashes on dorsal caudal and acute muscular hemorrhage
6/8/01	serious injury	adult male, #1102	58 mi east of Cape Cod, MA		P	Entangling gear deeply embedded; whale showing numerous signs of poor health including emaciation, skin discoloration, and abnormal cyamid distribution
6/18/01	mortality	female calf	Long Island, NY	P		Dorsal propeller wounds, sub-dermal hemorrhage
11/3/01	mortality	14 m male, #1238	Magdelen Islands, Canada		P	Thoroughly wrapped up in gear, whale seen alive and well five months earlier

STATUS OF STOCK

The size of this stock is considered to be extremely low relative to OSP in the US Atlantic EEZ, and this species is listed as endangered under the ESA. The North Atlantic right whale is considered one of the most critically endangered populations of large whales in the world (Clapham *et al.* 1999). A Recovery Plan has been published and is in effect (NMFS 1991), and a revised plan is under review. Three critical habitats, Cape Cod Bay/Massachusetts Bay, Great South Channel, and the Southeastern USA, were designated by NMFS (59 FR 28793, June 3, 1994). The NMFS ESA 1996 Northern Right Whale Status Review concluded that the status of the western North Atlantic population of the northern right whale remains endangered; this conclusion was reinforced by the International Whaling Commission (Best *et al.* 2001), which expressed grave concern regarding the status of this stock. The total level of human-caused mortality and serious injury is unknown, but reported human-caused mortality and serious injury has been a minimum of ~~1.8~~2.0 right whales per year from 199~~6~~7 through 200~~0~~1. Given that PBR has been set to zero, no mortality or serious injury for this stock can be considered insignificant. This is a strategic stock because the average annual fishery-related mortality and serious injury exceeds PBR, and because the North Atlantic right whale is an endangered species. Relative to populations of southern right whales, there are also concerns about growth rate, percentage of reproductive females, and calving intervals in this population.

REFERENCES

Aguilar, A. 1986. A review of old Basque whaling and its effect on the right whales of the North Atlantic. *Rep. int. Whal. Commn*, Special Issue 10: 191-199.
Best, P.B., Bannister, J.L., Brownell Jr., R.L., Donovan, G.P. (eds.) 2001. Right whales: worldwide status. *J. Cetacean Res. Manage.* (Special Issue) 2. 309pp.
Caswell, H., Brault, S. and Fujiwara, M. 1999. Declining survival probability threatens the North Atlantic right whale. *Proc. Natl. Acad. Sci. USA* 96: 3308-3313.
Clapham, P. J., S. B. Young and R. L. Brownell, Jr. 1999. Baleen whales: conservation issues and the status of the most endangered populations. *Mammal Review* 29: 35-60.
Hain, J. H. W. 1975. The international regulation of whaling. *Marine Affairs J.* 3: 28-48.
Hamilton, P. K., A. R. Knowlton, M. K. Marx and S. D. Kraus. 1998. Age structure and longevity in North Atlantic right whales *Eubalaena glacialis* and their relation to reproduction. *Marine Ecology Progress Series* 171: 285-292.
Hamilton, P. K., M. K. Marx, and S. D. Kraus. 1998. Scarification analysis of North Atlantic right whales (*Eubalaena glacialis*) as a method of assessing human impacts. Final report to the Northeast Fisheries Science Center, Contract No. 4EANF-6-0004.
IWC. 1999. Report of the workshop on the comprehensive assessment of right whales worldwide. *J. Cetacean Res. Manage.* 1 (supplement): 119-120.
Kenney, R. D., M. A. M. Hyman, R. E. Owen, G. P. Scott, and H. E. Won. 1986. Estimation of prey densities required by western North Atlantic right whales. *Mar. Mammal Sci.* 2(1): 1-13.
Kenney, R. D. and S. D. Kraus. 1993. Right whale mortality — a correction and an update. *Mar. Mammal Sci.* 9:445-446.
Kenney, R. D., H. E. Won, and M. C. Macaulay. 1995. Cetaceans in the Great South Channel, 1979-1989: right whale (*Eubalaena glacialis*). *Cont. Shelf Res.* 15: 385-414.
Knowlton, A. R., J. Sigurjonsson, J. N. Ciano, and S. D. Kraus. 1992. Long-distance movements of North Atlantic Right whales (*Eubalaena glacialis*). *Mar. Mammal Sci.* 8(4): 397-405.
Knowlton, A. R. and S. D. Kraus. 2001. Mortality and serious injury of North Atlantic right whales (*Eubalaena glacialis*) in the North Atlantic Ocean. *J. Cetacean Res. Manage.* (Special Issue) 2: 193-208.
Knowlton, A. R., S. D. Kraus, and R. D. Kenney. 1994. Reproduction in North Atlantic right whales (*Eubalaena glacialis*). *Can. J. Zool.* 72: 1297-1305.
Knowlton, A.R., M.K. Marx, H.M. Pettis, P.K. Hamilton and S.D. Kraus. 2001. Scarification analysis of North Atlantic right whales (*Eubalaena glacialis*): monitoring rates of entanglement interaction. Report to the National Marine Fisheries Service. Available from: New England Aquarium, Central Wharf, Boston, MA 02110.
Kraus, S. D. 1990. Rates and potential causes of mortality in North Atlantic right whales (*Eubalaena glacialis*). *Mar. Mammal Sci.* 6(4): 278-291.
Kraus, S. D., P. K. Hamilton, R. D. Kenney, A. Knowlton and C. K. Slay. 2001. Reproductive parameters of the North Atlantic right whale. *J. Cetacean Res. Manage.* (Special Issue) 2: 231-236.
Malik, S., M. W. Brown, S. D. Kraus, A. Knowlton, P. Hamilton and B. N. White. 1999. Assessment of genetic structuring and habitat philopatry in the North Atlantic right whale (*Eubalaena glacialis*). *Can. J. Zool.* 77: 1217-1222.
Malik, S., M. W. Brown, S. D. Kraus and B. N. White. 2000. Analysis of mitochondrial DNA diversity within and between North and South Atlantic right whales. *Mar. Mammal Sci.* 16: 545-558.
Mate, B. M., S. L. Nieukirk and S. D. Kraus. 1997. Satellite-monitored movements of the northern right whale. *J. Wildl. Manage.* 61: 1393-1405.
Mayo, C. A. and M .K. Marx. 1990. Surface foraging behaviour of the North Atlantic right whale, *Eubalaena glacialis*, and associated zooplankton characteristics. *Can. J. Zool.* 68: 2214-2220.
Moore, J. C. and E. Clark. 1963. Discovery of right whales in the Gulf of Mexico. *Science* 141(3577): 269.
NMFS. 1991. Recovery plan for the northern right whale (*Eubalaena glacialis*). Prepared by the Right Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland, 86 pp.
Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. *Rep. int. Whal. Commn.*, Special Issue 15: 133-147.

Reeves, R.R., R. Rolland, and P. Clapham (eds.). 2001. Report of the workshop on the causes of reproductive failure in North Atlantic right whales: new avenues of research. NOAA-NMFS-NEFSC Ref. Doc. 01-16. 46p. Available from: NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.

Reeves, R. R. and E. Mitchell. 1987. Shore whaling for right whales in the northeastern United States. Contract Report No. NA85-WCC-06194, Southeast Fisheries Science Center, Miami, FL, 108 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL, 33149.

Reeves, R. R., J. M. Breiwick and E. Mitchell. 1992. Pre-exploitation abundance of right whales off the eastern United States. Pages 5-7. *In*: J. Hain (ed.). *The right whale in the western North Atlantic: A science and management workshop, 14-15 April 1992, Silver Spring, Maryland*. NOAA-NMFS-NEFSC Ref. Doc. No. 92-05. 88 pp. Available from: NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.

Rosenbaum, H. C., M. Egan, P. J. Clapham, R. L. Brownell Jr. and R. DeSalle. 1997. An effective method for isolating DNA from non-conventional museum specimens. *Mol. Ecol*. 6: 677-681.

Rosenbaum, H.C., Egan, M.S., Clapham, P.J., Brownell, R.L. Jr., Malik, S., Brown, M.W., White, B.N., Walsh, P. and DeSalle, R. 2000. Utility of North Atlantic right whale museum specimens for assessing changes in genetic diversity. *Conservation Biology* 14: 1837-1842.

Schaeff, C. M., S. D. Kraus, M. W. Brown, J. Perkins, R. Payne and B. N. White. 1997. Comparison of genetic variability of North and South Atlantic right whales (*Eubalaena*) using DNA fingerprinting. *Can. J. Zool*. 75: 1073-1080.

Schmidly, D. J., C. O. Martin and G. F. Collins. 1972. First occurrence of a black right whale (*Balaena glacialis*) along the Texas coast. *Southw. Nat*. 17(2): 214-215.

Wade, P. R., and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop, April 3-5, 1996, Seattle, Washington. NOAA Technical Memorandum NMFS-OPR-12. U.S. Dept. of Commerce, Washington, D.C. 93 pp.

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*. 2001). During the recent Comprehensive Assessment of North Atlantic humpback whales, the International Whaling Commission acknowledged the evidence for treating the Gulf of Maine as a separate stock for the purpose of management (IWC 2002).

During the summers of 1998 and 1999, the Northeast Fisheries Science Center conducted surveys for humpback whales on the Scotian Shelf. The objective of these surveys was 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 Center for Coastal Studies, respectively); this work is summarized in Clapham *et al*. (200~~1a~~2). The match rate between the Scotian Shelf and the Gulf of Maine was 2~~5~~7% (1~~3~~4 of 5~~3~~2 Scotian Shelf individuals from both years). Comparable rates of exchange were obtained from the southern (2~~4~~6%, ~~n=9~~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, ~~almost all~~all (36 of 36) humpback whales identified by the same NMFS surveys elsewhere in the Gulf of Maine (including ~~from the~~Georges Bank, southwestern ~~shore of~~ Nova Scotia and the Bay of Fundy ~~area~~) had been previously observed in the Gulf of Maine region. The sighting histories of the 1~~3~~4 Scotian Shelf whales matched to the Gulf of Maine suggested that ~~most~~many of them were transient through the latter area. ~~Only one~~There were no matches between the Scotian Shelf ~~animal was matched to~~and any ~~other~~ North Atlantic feeding ground, ~~Newfoundland~~except the Gulf of Maine; however, instructive comparisons are compromised by the ~~lack of~~often low sampling effort in ~~that~~other regions in recent years. Overall, while it is not possible to define the Gulf of Maine population by drawing a strict geographical boundary, it appears that the effective range of many members of this stock does not extend onto the Scotian Shelf. Further work on the Scotian Shelf ~~is planned for 2002~~was conducted in August 2002; the results of this cruise are expected to further clarify the issue of stock identity from this region. The very low match rate between the two sampled years (only one animal was resighted in the region in both 1998 and 1999) suggests that the Scotian Shelf is host to a larger population of humpback whales than was previously thought.

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 and 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 (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 which occurred during 1985-1992 in the US 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 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. This topic was recently investigated using fluke photographs of living and dead whales observed in the region (Barco *et al*. 200~~1~~2). 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*. (200~~1~~2) suggested that the mid-Atlantic region primarily represents a supplemental winter feeding ground that is used by humpbacks for more than one purpose.

Feeding is the principal activity of humpback whales in New England waters, and their distribution in ~~New England waters~~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 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 1992-1993, 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 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 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) was estimated from genetic tagging data collected by the YONAH project in the breeding range at 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 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 11,570 for 1992/93 (CV=0.069, Stevick *et al.* 2001), and an additional genotype-based analysis yielded a similar but less precise estimate of 10,400 (95% CI=8,000 to 13,600) (Smith *et al.* 1999). The estimate of 11,570 (CV=0.069) is regarded as the best available estimate for the North Atlantic, although because YONAH sampling was not spatially representative in the feeding grounds, this figure 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, and line-transect 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 was probably less subject to this bias.

The second approach uses photo-identification data to establish the minimum number of humpback whales known to be 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 used 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 8,212 km. 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) that 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 somewhat 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 figures for abundance and minimum population size given above falls 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. CCS = Center for Coastal Studies. COA = College of the Atlantic.

Month/Year	Type	N	CV	Source
1992/93	Mark-recapture estimate	652	0.29	Clapham *et al.* (200~~1a~~2)
1997	Minimum known to be alive	497	-	CCS + COA data
July/August 1999	Line transect, including a portion of the Scotian Shelf stratum	902	0.41	Palka 2000, Clapham *et al.* 200~~1a~~2

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 3.2% (SE=0.005) in the North Atlantic population overall for the period 1979–1993 (Stevick *et al.* 2001), 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.* 2000; Clapham *et al.* 2001b). 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.* (2000). This suggests that the observed rate of 6.5% (Barlow and Clapham 1997) was close to the maximum for this stock.

Clapham *et al.* (200~~1a~~2) updated the Barlow and Clapham (1997) analysis using data from the period 1992 to 2000. The 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 (1992-95) 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 occurs. If the decline is a real phenomenon 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 estimate of population growth rate for the Gulf of Maine, for purposes of this assessment the maximum net productivity rate was assumed to be the default value for cetaceans of 0.04 (Barlow *et al.* 1995).

Current and maximum net productivity rates are unknown for the North Atlantic population overall. As noted above, Stevick *et al.* (2001) calculated an average population growth rate of 3.2% (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 199~~6~~7 through 200~~0~~1, the total estimated human-caused mortality and serious injury to the Gulf of Maine humpback whale stock is estimated as ~~3.0~~2.6 per year (USA waters, 2.~~4~~0; Canadian waters, 0.6). This average is derived from two components: 1) incidental fishery interaction records, 2.~~8~~2 (USA waters, ~~2.2~~1.6; Canadian waters, 0.6); and 2) records of vessel collisions, 0.~~2~~4 (USA waters, 0.~~2~~4; Canadian waters, 0). There were additional humpback mortalities and serious injuries that occurred in the southeastern and mid-Atlantic states that could not be confirmed as involving members of the Gulf of Maine stock. These records represent an additional minimum annual average of 1.6 human-caused mortalities and serious injuries to humpbacks over the time period, of which 1.~~0~~2 per year are attributable to incidental fishery interactions and 0.~~6~~4 per year are attributable to vessel collisions.

Note that in the ~~1996 and~~ 1998 stock assessment report~~s~~, a six-year time frame was used to calculate the averages for fishery interactions and vessel collisions. A five-year period has been used since to be consistent with the time frames used for calculating the averages for the observed fishery and for other species. Beginning with the 2001 Stock Assessment Report, Canadian records were incorporated into the mortality and serious injury rates~~ of this report~~, to reflect the effective range of this stock as described above. ~~Beginning with this report~~In addition, 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 ~~net~~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 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 substantiated evidence that the injury, whether from entanglement or vessel collision, was likely to lead to the whale's death. Injuries that impeded the 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 may 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 must be considered 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 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.

An updated analysis of humpback whale mortalities from the mid-Atlantic states region has recently been produced by Barco *et al.* (200~~1~~2). Between 1990 and 2000, there were 52 known humpback whale mortalities in the waters of the U.S. mid-Atlantic states~~ (summarized by Barco *et al.* 2001)~~. 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 is suggested by the stranded sample.

In their study of entanglement rates estimated from caudal peduncle scars, Robbins and Mattila (2001) found that males were more likely to be entangled than females. The scarring data also 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 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.

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.

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 and 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~~NMFS. A number of these records (11 entanglements involving lobster gear) from the 1990-1994 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 199~~6~~7 through 200~~0~~1 were reviewed. Out of ~~99~~106 records, ~~over~~ 8~~0~~5 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, the Gulf of Maine stock sustained ~~2~~3 mortalities attributable to fishery interactions and ~~12~~8 cases of serious injuries — ~~14~~11 records in the five-year period (Table 2). In addition, ~~2~~4 mortalities and ~~3~~2 serious injuries were documented in the southeastern and mid-Atlantic states that involved interactions with fisheries. At the time of this writing, no genetic results were 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 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. 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. 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 bycatches 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). Since this fishery no longer exists, records of its incidental takes have been excluded from Table 2.

Table 2. Summarized records of mortality and serious injury likely to result in mortality, for North Atlantic humpback whales, January 199~~6~~7 - December 200~~0~~1. Causes of mortality or injury, assigned as primary or secondary, are based on records maintained by ~~NMFS/NER and NMFS/SER~~NMFS. Records counted as from the Gulf of Maine humpback whale stock are indicated by an asterisk (*) following the date.

Date	Report Type	Sex, age, ID length	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
~~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~~

Date	Report Type	Sex, age, ID length	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
~~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~~
~~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~~	~~Carritück, 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
5/3/98*	mortality	10.2 m male	Cape Cod, MA		P	fresh entanglement lesions around head and flippers
7/19/98*	serious injury	age and sex unknown	Bay of Fundy, Canada		P	whale partially disentangled from gillnet gear, but swam away still badly wrapped
8/4/98*	serious injury	age and sex unknown	Mount Desert Rock (44° 06' 67° 44')		P	line through mouth and several wraps around tail with fresh chaffing
8/23/98*	serious injury	adult, sex unknown	Montauk Pt., NY (40° 36' 70° 43')		P	whale anchored by offshore lobster gear, struggling to breathe; not relocated by Coast Guard search

Date	Report Type	Sex, age, ID length	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
11/5/98	mortality	8.9 m male	Nags Head, NC (35° 59' 75° 38')		P	Deep abrasions around tail stock with subdermal hemorrhaging
1/12/99*	mortality	9.~~7~~7 m male	Martha's Vineyard, MA		P	Fresh and extensive rope marks on carcass with associated hemorrhaging
8/2/99*	serious injury	9.~~4~~4 m estimated	Bay of Fundy, Canada		P	Single wrap of ½ inch poly line pinning flippers
9/23/99*	serious injury	unknown	off Chatham, MA		P	Line out of mouth and several wraps around body; possibly anchored
1/8/00	serious injury	9.9 m 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
8/4/00*	serious injury	10.7 m estimated	Bay of Fundy, Canada		P	gillnet wrapped on head with weighted trailing line giving tension
9/6/00*	serious injury	<1 y~~-~~r o~~-~~ld, calf of "Giraffe"	Stellwagen Bank, MA		P	single line wrapped across back; constriction will increase as whale grows
10/14/00	serious injury	9.~~9~~9 m estimated	off Ocean City Inlet, MD		P	Heavily entangled in line and netting; constrictive--fresh wounds noted
10/20/00*	serious injury	10 y~~-~~r o~~-~~ld male "Tribble"	Stellwagen Bank, MA		P	Entangled in green poly line on multiple body parts; appears constrictive
1/25/01	mortality	6.9 m estimated	Avon, NC	P		extensive hemorrhaging along left thoracic, clean cut through center of vertebrae; ship strike
4/8/01	mortality	7.9 m juvenile male	Myrtle Beach, SC	S	P	pre-mortem evidence of chronic line entanglement; severe prop wounds
4/8/01	mortality	7.6 m juvenile male	Emerald Isle, NC		P	entanglement around peduncle caused extensive edema, hemorrhaging

Date	Report Type	Sex, age, ID length	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
4/9/01*	mortality	8.8 m juvenile female "Inland"	offshore of Sandbridge, Virginia Beach		P	found anchored in gillnet gear; line wraps around rostrum had immobilized the whale
7/29/01*	mortality	8.5 m juvenile female	floating south of Verazano Bridge, NY	P		large laceration on left side of head, extensive fracturing of skull
10/1/01*	mortality	11.4 m 3 yr old female "Pitfall"	Duxbury Beach, MA	P		massive fracturing to skull, focal bruising indicative of pre-mortem ship strike

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 first 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.

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. 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~~NMFS records for 199~~6~~7 through 200~~0~~1, ~~8~~11 records had some evidence of a collision with a vessel. Of these, 4 were mortalities as a result of the collision, ~~3~~and 5 did not have sufficient information to confirm the collision as the cause of death~~, and for 1, the seriousness of the injury could not be assessed. This~~. Of the remaining 2, one 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 sustained had healed. The last record involved a whale watch vessel that collided with a humpback on 8/2/98; the seriousness of the injury could not be assessed. The whale was sighted after the collision with a large gash in its back, but was reported as "not struggling to breathe". It was seen in the company of other humpbacks several times over three weeks following the incident. However, among the members of this cohort with similar sighting history patterns through 1998, this injured animal was the only one that has not been resighted in subsequent years. ~~It is the only member of its cohort to not be resighted.. Only~~

oneTwo out of the 4 cases of a mortality from a vessel collision involved a whales identified as a members of the Gulf of Maine stock (on 4/2/96 7/29/01 and 10/1/01; see Table 2).

In 2001, a total of 20 humpback whale mortalities were reported. Three of the carcasses had indications of a collision with a vessel, and 3 others showed signs of entanglement. Also in 2001, 7 entanglements and 2 vessel collisions were reported. In 2002, 7 mortalities and 7 entanglements involving humpbacks had been reported at the time of this writing. A comprehensive review of all available information pertaining to these reports has not been completed, and therefore determinations of the total levels of anthropogenic mortality and serious injury for these years have yet to be done.

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; thisthese meetings conducted a detailed review of all aspects of this population (IWC 2002). Although the most recent estimates of abundance indicate continued population growth, the size of the humpback whale stock may be below OSP in the US 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 average annual rate of population increase was estimated at 3.2% (SE=0.005, Stevick *et al.* 2001). As noted above, a recent analysis of demographic parameters for the Gulf of Maine (Clapham *et al.* 2001a2) 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 human-caused mortality and serious injury is unknown, but current data indicate that it is significant. In particular, the continued high level of mortality among humpback whales off the U.S. mid-Atlantic states (Barco *et al.*. 20012), is cause for considerable concern given that at least some of these animals are known to be from the Gulf of Maine. This is a strategic stock because the average annual fishery-related mortality and serious injury exceeds PBR, and because the North Atlantic humpback whale is an endangered species.

~~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.~~

REFERENCES

Balcomb, K. C. and G. Nichols. 1982. Humpback whale censuses in the West Indies. *Rep. int. Whal. Commn.* 32: 401-406.

Barco, S., McLellan, W.A., Allen, J., Asmutis, R., Mallon-Day, R., Meagher, E., Pabst, D.A., Robbins, J., Seton, R., Swingle, R.M., Weinrich, M.T, and Clapham, P. 2002. Population identity of humpback whales in the waters of the U.S. mid-Atlantic states. *J. Cetacean Res. Manage.* (in press).

Barlow, J., and P. J. Clapham. 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. *Ecology* 78 (2): 535-546.

Brandão, A., D. S. Butterworth and M.R. Brown. 2000. Maximum possible humpback whale increase rates as a function of biological parameter values. *J. Cetacean Res. Manage.* 2 (supplement): 192-193.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the USA outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Christensen, I., T. Haug, and N. Øien. 1992. Seasonal distribution, exploitation and present abundance of stocks of large baleen whales (Mysticeti) and sperm whales (*Physeter macrocephalus*) in Norwegian and adjacent waters. *ICES J. Mar. Sci.* 49: 341-355.

Clapham, P. J. and C. A. Mayo. 1987. Reproduction and recruitment of individually identified humpback whales, *Megaptera novaeangliae*, observed in Massachusetts Bay, 1979-1985. *Can. J. Zool.* 65: 2853-2863.

Clapham, P. J. and C. A. Mayo. 1990. Reproduction of humpback whales (*Megaptera novaeangliae*) observed in the Gulf of Maine. *Rep. int. Whal. Commn.* Special Issue 12: 171-175.

Clapham, P. J. 1992. Age at attainment of sexual maturity in humpback whales, *Megaptera novaeangliae*. *Can. J. Zool*. 70: 1470-1472.

Clapham, P. J., L. S. Baraff, C. A. Carlson, M. A. Christian, D. K. Mattila, C. A. Mayo, M. A. Murphy, and S. Pittman. 1993. Seasonal occurrence and annual return of humpback whales, *Megaptera novaeangliae*, in the southern Gulf of Maine. *Can. J. Zool*. 71: 440-443.

Clapham, P.J., Bérubé, M.C. & Mattila, D.K. 1995. Sex ratio of the Gulf of Maine humpback whale population. *Mar. Mammal Sci*. 11: 227-231.

Clapham, P.J., Barlow, J., Cole, T., Mattila, D., Pace, R., Palka, D.. Robbins, J. and Seton, R. ~~2001a~~2001~~a~~2. Stock definition, abundance and demographic parameters of humpback whales from the Gulf of Maine. *J. Cetacean Res. Manage.* (in press).

Clapham, P.J., Robbins, J., Brown, M., Wade, P. and Findlay, K. ~~2001b~~2001~~b~~. A note on plausible rates of population growth for humpback whales. *J. Cetacean Res. Manage.* 3 (suppl.): 196-197.

Fogarty, M. J., E. B. Cohen, W. L. Michaels, and W. W. Morse. 1991. Predation and the regulation of sand lance populations: An exploratory analysis. *ICES Mar. Sci. Symp*. 193: 120-124.

Geraci, J. R., D. M. Anderson., R. J. Timperi, D. J. St. Aubin., G. A. Early, J. H. Prescott and C. A. Mayo. 1989 Humpback whales (*Megaptera novaeangliae*) fatally poisoned by dinoflagellate toxins. *Can. J. Fish. Aquat. Sci*. 46: 1895-1898.

IWC. 2002. Report of the Scientific Committee. Annex H: Report of the Sub-committee on the Comprehensive Assessment of North Atlantic humpback whales. *J. Cetacean Res. Manage.* 3 (supplement) (in press).

Katona, S. K., and J. A. Beard. 1990. Population size, migrations, and feeding aggregations of the humpback whale (*Megaptera novaeangliae*) in the western North Atlantic ocean. *Rep. int. Whal. Commn*. Special Issue 12: 295-306.

Katona, S. K., J. M. Allen, and P. Stevick. 1994. Maintaining the North Atlantic humpback whale catalog. Progress report to the Northeast Fisheries Science Center, Contract No. 50EANF-1-00056, May 1994, 26 pp. Available from: NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.

Larsen, A. H., J. Sigurjónsson, N. Øien, G. Vikingsson, and P. J. Palsbøll. 1996. Population genetic analysis of mitochondrial and nuclear genetic loci in skin biopsies collected from central and northeastern North Atlantic humpback whales (*Megaptera novaeangliae*): population identity and migratory destinations. *Proceedings of the Royal Society of London* B 263: 1611-1618.

Levenson, C. and Leapley, W.T. 1978. Distribution of humpback whales (*Megaptera novaeangliae*) in the Caribbean determined by a rapid acoustic method. *J. Fish. Res. Bd. Can*. 35: 1150-1152.

Lien, J., W. Ledwell, and J. Naven. 1988. Incidental entrapment in inshore fishing gear during 1988: A preliminary report to the Newfoundland and Labrador Department of Fisheries and Oceans, 15 pp.

Mattila, D. K. and P. J. Clapham. 1989. Humpback whales and other cetaceans on Virgin Bank and in the northern Leeward Islands, 1985 and 1986. *Can. J. Zool*. 67: 2201-2211.

Mattila, D. K., P. J. Clapham, S. K. Katona and G. S. Stone. 1989. Population composition of humpback whales on Silver Bank. *Can. J. Zool*. 67: 281-285.

Mattila, D.K., Clapham, P.J., Vásquez, O. & Bowman, R. 1994. Occurrence, population composition and habitat use of humpback whales in Samana Bay, Dominican Republic. *Canadian Journal of Zoology* 72: 1898-1907.

NMFS. 1991. Recovery plan for the humpback whale (*Megaptera novaeangliae*). Prepared by the Humpback Whale Recovery Team for the National Marine Fisheries Service, Silver Spring, MD, 105 pp.

Northridge, S. 1996. Estimation of cetacean mortality in the USA Atlantic swordfish and tuna drift gillnet and pair trawl fisheries. Report to the Northeast Fisheries Science Center, Contract No. 40ENNF500160. 21p. Available from: NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.

Øien, N. 1990. Sighting surveys in the northeast Atlantic in July 1988: distribution and abundance of cetaceans. *Rep. int. Whal. Commn*. 40: 499-511.

Øien, N. 2001. Humpback whales in the Barents and Norwegian Seas. Paper SC/53/NAH21 presented to the International Whaling Commission Scientific Committee. Available from IWC, 135 Station Road, Impington, Cambridge, UK.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. *Rep. int Whal. Commn.* (special issue) 16: 27-50.

Palka, D. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. NMFS, Northeast Fisheries Science Center Ref. Doc. 00-07; 29 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543.

Paquet, D., C. Haycock and H. Whitehead. 1997. Numbers and seasonal occurrence of humpback whales (*Megaptera novaeangliae*) off Brier Island, Nova Scotia. *Can. Field Nat.* 111: 548-552.

Palsbøll, P. J., J. Allen,, M. Bérubé, P. J. Clapham, T. P. Feddersen, P. Hammond, H. Jørgensen, S. Katona, A. H. Larsen, F. Larsen, J. Lien, D. K. Mattila, J. Sigurjónsson, R. Sears, T. Smith, R. Sponer, P. Stevick and N. Øien. 1997. Genetic tagging of humpback whales. *Nature* 388: 767-769.

Palsbøll, P.J., P. J. Clapham, D. K. Mattila, F. Larsen, R. Sears, H. R. Siegismund, J. Sigurjónsson, O. Vásquez and P. Arctander. 1995. Distribution of mtDNA haplotypes in North Atlantic humpback whales: the influence of behavior on population structure. *Marine Ecology Progress Series* 116: 1-10.

Palsbøll, P.J., Allen, J. Anderson, T.H., Bérubé, M., Clapham, P.J., Feddersen, T.P., Friday, N., Hammond, P., Jørgensen, H., Katona, S.K., Larsen, A.H., Larsen, F., Lien, J., Mattila, D.K., Nygaard, F.B., Robbins, J., Sponer, R., Sears, R., Sigurjónsson, J., Smith, T.D., Stevick, P.T., Vikingsson, G. and Øien, N. 2001. Stock structure and composition of the North Atlantic humpback whale, *Megaptera novaeangliae*. Paper SC/53/NAH11 presented to the International Whaling Commission Scientific Committee. Available from IWC, 135 Station Road, Impington, Cambridge, UK.

Payne, P. M., J. R. Nicholas, L. O'Brien, and K. D. Powers. 1986. The distribution of the humpback whale, *Megaptera novaeangliae*, on Georges Bank and in the Gulf of Maine in relation to densities of the sand eel, *Ammodytes americanus*. *Fish. Bull., U.S.* 84: 271-277.

Payne, P. M., D. N. Wiley, S. B. Young, S. Pittman, P. J. Clapham, and J. W. Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. *Fish. Bull., U.S.* 88(4): 687-696.

Price, W. S. 1985. Whaling in the Caribbean: historical perspective and update. *Rep. int. Whal. Commn.* 35: 413-420.

Reiner, F., M. E. Dos Santos, and F. W. Wenzel. 1996. Cetaceans of the Cape Verde archipelago. *Mar. Mammal Sci.* 12: 434-443.

Robbins, J. and D.K. Mattila. 2001. Monitoring entanglements of humpback whales (*Megaptera novaeangliae*) in the Gulf of Maine on the basis of caudal peduncle scarring. Paper SC/53/NAH25 presented to the International Whaling Commission Scientific Committee. Available from IWC, 135 Station Road, Impington, Cambridge, UK.

Smith, T. D., J. Allen, P. J. Clapham, P. S. Hammond, S. Katona, F. Larsen, J. Lien, D. Mattila, P. J. Palsbøll, J. Sigurjónsson, P. T. Stevick and N. Øien. 1999. An ocean-basin-wide mark-recapture study of the North Atlantic humpback whale (*Megaptera novaeangliae*). *Mar. Mammal Sci.* 15(1):1-32.

Stevick, P.T., Allen, J., Clapham, P.J., Friday, N., Katona, S.K., Larsen, F., Lien, J., Mattila, D.K., Palsbøll, P.J., Sears, R., Sigurjónsson, J., Smith, T.D., Vikingsson, G., Øien, J. and Hammond, P.S. 2001. Trends in abundance of North Atlantic humpback whales, 1979-1993. Paper SC/53/NAH2 presented to the International Whaling Commission Scientific Committee. Available from IWC, 135 Station Road, Impington, Cambridge, UK.

Stevick, P., N. Øien and D. K. Mattila. 1998. Migration of a humpback whale between Norway and the West Indies. *Mar. Mammal Sci.* 14: 162-166.

Swingle, W. M., S. G. Barco, T. D. Pitchford, W.A. McLellan and D.A. Pabst. 1993. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. *Mar. Mammal Sci.* 9: 309-315.

Volgenau, L., S. D. Kraus, and J. Lien. 1995. The impact of entanglements on two substocks of the western North Atlantic humpback whale, *Megaptera novaeangliae*. *Can. J. Zool.* 73: 1689-1698.

Wade, P. R., and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop, April 3-5, 1996, Seattle, Washington. NOAA Technical Memorandum NMFS-OPR-12. U.S. Dept. of Commerce, Washington, DC. 93 pp.

Waring, G. T., D.L. Palka, P. J. Clapham, S. Swartz, M. C. Rossman, T. V. N. Cole, K. D. Bisack and L. J. Hansen. 1999. U.S. Atlantic marine mammal stock assessment reports — 1998. NOAA Tech. Memo. NMFS-NE-116, 182 pp.

Whitehead, H. and M.J. Moore. 1982. Distribution and movements of West Indian humpback whales in winter. *Can. J. Zool*. 60: 2203-2211.

Wiley, D. N., R. A. Asmutis, T. D. Pitchford, and D. P. Gannon. 1995. Stranding and mortality of humpback whales, *Megaptera novaeangliae*, in the mid-Atlantic and southeast United States, 1985-1992. *Fish. Bull., U.S.* 93: 196-205.

Winn, H. E., R. K. Edel and A. G. Taruski. 1975. Population estimate of the humpback whale (*Megaptera novaeangliae*) in the West Indies by visual and acoustic techniques. *J. Fish. Res. Bd. Can*. 32: 499-506.

FIN WHALE (*Balaenoptera physalus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Scientific Committee of the International Whaling Commission (IWC) has proposed stock boundaries for North Atlantic fin whales. Fin whales off the eastern USA, north to Nova Scotia and ~~on to~~ the southeastern coast of Newfoundland are believed to constitute a single stock under the present IWC scheme (Donovan 1991). However, the stock identity of North Atlantic fin whales has received relatively little attention, and whether the current stock boundaries define biologically isolated units has long been uncertain. The existence of a subpopulation structure was suggested by local depletions that resulted from commercial overharvesting (Mizroch *et al*. 1984).

A genetic study conducted by Bérubé *et al.* (1998) using both mitochondrial and nuclear DNA provided strong support for an earlier population model proposed by Kellogg (1929) and others. This postulates the existence of several subpopulations of fin whales in the North Atlantic and Mediterranean, with limited gene flow among them. Bérubé *et al.* (1998) also proposed that the North Atlantic population showed recent divergence due to climatic changes (*i.e.* postglacial expansion), as well as substructuring over even relatively short distances. The genetic data are consistent with the idea that different subpopulations use the same feeding ground, a hypothesis that was also originally proposed by Kellogg (1929).

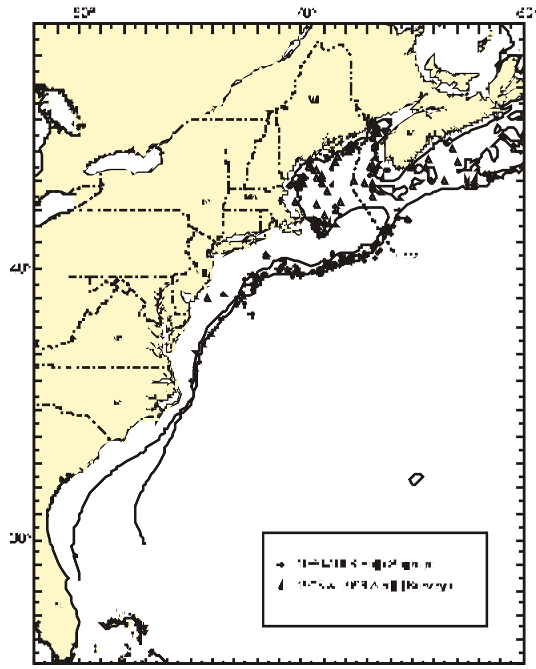

Figure 1. *Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1990-1998. Isobaths are at 100 m and 1,000 m.*

Fin whales are common in waters of the US Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward (Figure 1). Fin whales accounted for 46% of the large whales and 24% of all cetaceans sighted over the continental shelf during aerial surveys (CETAP 1982) between Cape Hatteras and Nova Scotia during 1978-82. While a great deal remains unknown, the magnitude of the ecological role of the fin whale is impressive. In this region fin whales are probably the dominant large cetacean species in all seasons, with the largest standing stock, the largest food requirements, and therefore the largest impact on the ecosystem of any cetacean species (Kenney *et al*. 1997; Hain *et al*. 199~~3~~2).

There is little doubt that New England waters represent a major feeding ground for the fin whale. There is evidence of site fidelity by females, and perhaps some segregation by sexual, maturational or reproductive class on the feeding range (Agler *et al*. 1993). Seipt *et al*. (1990) reported that 49% of identified fin whales on Massachusetts Bay area feeding grounds were resighted within the same year, and 45% were resighted in multiple years. While recognizing localized as well as more extensive movements, these authors suggested that fin whales on these grounds exhibited patterns of seasonal occurrence and annual return that are in some respects similar to those shown for humpback whales. This was reinforced by Clapham and Seipt (1991), who showed maternally directed site fidelity by fin whales in the Gulf of Maine. Information on life history and vital rates is also available in data from the Canadian fishery, 1965-1971 (Mitchell 1974). In seven years, 3,528 fin whales were taken at three whaling stations. The station at Blandford, Nova Scotia, took 1,402 fin whales.

Hain *et al*. (19932), based on an analysis of neonate stranding data, suggested that calving takes place during approximately four months from October to January in latitudes of the US mid-Atlantic region; however, it is unknown where calving, mating, and wintering for most of the population occurs. Results from the Navy's SOSUS program (Clark 1995) indicate a substantial deep-ocean component to fin whale distribution. It is likely that fin whales occurring in the US Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions. However, the popular notion that entire fin whale populations make distinct annual migrations like some other mysticetes has questionable support in the data; in the North Pacific, year-round monitoring of fin whale calls found no evidence for large-scale migratory movements (Watkins *et al*. 2000).

POPULATION SIZE

Two estimates of abundance from line--transect surveys are available. An abundance of 2,200 (CV=0.24) fin whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence. Total track line length was 32,600 km. The ships covered waters between the 50- and 1000-fathom isobaths, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the mid-Atlantic from the coastline to the 50-fathom isobath, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000-fathom isobath. Data collection and analysis methods used were described in Palka (1995).

A more recent estimate of 2,814 (CV=0.21) fin whales was derived 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 8,212 km. Similar to that used in the above 1995 Virginia to Gulf of St. Lawrence survey, shipboard Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that 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).

The latter abundance estimate is considered the best available for the western North Atlantic fin whale because it is relatively recent. However, this estimate must be considered extremely conservative in view of the known range of the fin whale in the entire western North Atlantic, andthe uncertainties regarding population structure and exchange between surveyed and unsurveyed areas, and aerial data having not been corrected for *g(0)*.

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 fin whales is 2,814 (CV=0.21). The minimum population estimate for the western North Atlantic fin whale is 2,362.

Current Population Trend

There are insufficient data to determine population trends for this species. Even at a conservatively estimated rate of increase, however, the numbers of fin whales may have increased substantially in recent years (Hain *et al*. 1993).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Based on photographically identified fin whales, Agler *et al*. (1993) estimated that the gross annual reproduction rate was at 8%, with a mean calving interval of 2.7 years.

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 2,362. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because the fin whale is listed as endangered under the Endangered Species Act (ESA). PBR for the western North Atlantic fin whale is 4.7.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The number of fin whales taken at three whaling stations in Canada from 1965 to 1971 totaled 3,528 whales (Mitchell 1974). Reports of non-directed takes of fin whales are fewer over the last two decades than for other endangered large whales such as right and humpback whales. There was no reported fishery-related mortality or serious injury to fin whales in fisheries observed by NMFS during 199~~5~~7 through ~~1999~~2001. A review of ~~NER/NMFS anecdotal~~NMFS records from 199~~6~~7 through 200~~0~~1 yielded an average of ~~1.6~~2.0 human~~-~~-caused mortalities per year – 0.~~4~~6 per year resulting from fishery interactions/entanglements (USA waters, 0.2; Canadian waters, 0.2; Bermudian waters, 0.2), and 1.~~2~~4 due to vessel collisions--all in USA waters (Table 1).

Fishery-Related Serious Injury and Mortality

No confirmed fishery-related mortality or serious injury of fin whales was reported in the Sea Sampling bycatch database; therefore, no detailed fishery information is presented here. A review of the records of stranded, floating or injured fin whales for the period 199~~6~~7 through 200~~0~~1 on file at ~~NER/NMFS~~NMFS found ~~two~~three records with substantial evidence of fishery interactions causing mortality or serious injury (Table 1). There was a live fin whale sighted entangled on 6/24/97 with line wrapped over its back. The animal appeared emaciated, and scarring visible on the leading edge of the dorsal fin and the whale's left flank suggests this was a prolonged entanglement. Whether the entanglement initiated the whale's decline in health is unclear, but the chronic stress of the entanglement ~~is~~was likely lethal given the whale's depressed condition.

The ~~two~~three substantiated records provide a minimum annual rate of serious injury and mortality of 0.~~4~~6 fin whales from fishery interactions. While these records are not statistically quantifiable in the same way as the observed fishery records, they give a minimum estimate of the frequency of entanglements for this species. In addition to the records above, there are ~~five~~four records within the period that lacked substantial evidence of the severity of the entanglement for a serious injury determination, or that did not provide the detail necessary to determine if an entanglement had been a contributing factor in the mortality.

Table 1. Summarized records of mortality and serious injury likely to result in mortality, Western North Atlantic fin whale stock, January 19967 - December 20001. Causes of mortality or injury, assigned as primary or secondary, are based on records maintained by ~~NMFS/NER and NMFS/SER~~NMFS.

Date	Report Type	Sex, age, ID length	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
~~12/20/96~~	~~mortality~~	~~14.0 m male~~	~~Savannah, GA~~	~~P~~		~~hematoma and broken ribs on right side~~
6/24/97	serious injury	unknown	20 mi east Nantucket Island, MA		P	line wrapped over back; whale emaciated; scarring indicative of prolonged entanglement
8/4/97	mortality	16.8 m female	Eastham, MA	P		exhumed skeleton with broken jaw, cracked scapula partially healed
3/21/98	mortality	16.9 m female	Salvo County, NC	P		large hematoma, disarticulated spine and numerous broken vertebrae
9/28/98	mortality	unknown	Digby Neck, Nova Scotia		P	gear wrapped through mouth and ten wraps on tail stock
2/10/99	mortality	15.5 m male	Virginia Beach, VA	P		large external wound, extensive fractures to vertebral column, hemorrhaging
11/5/99	mortality	16.2 m male	Elizabeth, NJ	P		large wound anterior of the blowhole, severed left flipper, shattered bones
12/11/00	mortality	10.9 m female	New York harbor	P		hemorrhage and fractured bones on right side
1/2/01	mortality	18.1 m female	New York harbor	P		dorsal abrasion marks, hematoma
2/1/01	mortality	14.5 m female	Port Elizabeth, NJ	P		Very fresh carcass hung on ship's bow
9/19/01	mortality	10.7 m unknown	off Bermuda		P	Extensive fresh entanglement marks

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 first 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.

Other Mortality

After reviewing ~~NER/NMFS~~NMFS records for 199~~6~~7 through 200~~0~~1, ~~six~~seven were found that had sufficient information to confirm the cause of death as collisions with vessels (Table 1). One record (8/4/97) had been omitted from previous reports, but is inserted here following an examination of the exhumed skeletal remains which found a broken jaw and cracked scapula which had partially healed. The partial healing indicates the whale was alive at the time of the incident.

The above records constitute an annual rate of serious injury or mortality of 1.~~2~~4 fin whales from collisions with vessels. ~~NMFS/NER~~NMFS data holdings include ~~five~~four additional records of fin whale collisions with vessels, but the available supporting documentation was ~~not conclusive as to whether these constituted serious injury or were the proximal cause of the mortality. Continuing follow-up efforts may yield additional confirmed events from these records.~~insufficient to determine if the whales sustained mortal injuries from the encounters.

STATUS OF STOCK

The status of this stock relative to OSP in the US Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine the population trend for fin whales. The total level of human-caused mortality and serious injury is unknown. The records on hand at ~~NER/NMFS~~NMFS represent coverage of only a portion of the area surveyed for the population estimate for the stock. Despite this, 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. This is a strategic stock because the fin whale is listed as an endangered species under the ESA. A Recovery Plan for fin whales has been prepared and is currently awaiting legal clearance.

REFERENCES

Agler, B. A., R. L. Schooley, S. E. Frohock, S. K. Katona, and I. E. Seipt. 1993. Reproduction of photographically identified fin whales, *Balaenoptera physalus*, from the Gulf of Maine. *J. Mamm.* 74(3): 577-587.

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Technical Memorandum NMFS-OPR-6. U.S. Department of Commerce, Washington, DC. 73 pp.

Bérubé, M., A. Aguilar, D. Dendanto, F. Larsen, G. Notarbartolo di Sciara, R. Sears, J. Sigurjónsson, J. Urban-R. and P. J. Palsbøll. 1998. Population genetic structure of North Atlantic, Mediterranean and Sea of Cortez fin whales, *Balaenoptera physalus* (Linnaeus 1758): analysis of mitochondrial and nuclear loci. *Mol. Ecol.* 15: 585-599.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Clapham, P. J. and I. E. Seipt. 1991. Resightings of independent fin whales, *Balaenoptera physalus*, on maternal summer ranges. *J. Mamm.* 72: 788-790.

Clark, C. W. 1995. Application of U.S. Navy underwater hydrophone arrays for scientific research on whales. *Rep. int. Whal. Commn.* 45: 210-212.

Donovan, G. P. 1991. A review of IWC stock boundaries. *Rep. int. Whal. Commn.* Special Issue 13: 39-68.

Hain, J. H. W., M. J. Ratnaswamy, R. D. Kenney, and H. E. Winn. 1993. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. *Rep. int. Whal. Commn.* 42: 653-669.

Kellogg, R. 1929. What is known of the migration of some of the whalebone whales. *Ann. Rep. Smithsonian Inst.* 1928: 467-494.

Kenney, R. D., G. P. Scott, T. J. Thompson, and H. E. Winn. 1997. Estimates of prey consumption and trophic impacts of cetaceans in the USA northeast continental shelf ecosystem. *J. Northw. Atl. Fish. Sci.* 22: 155-171.

Mizroch, A. A., D. W. Rice and J. M. Breiwick. 1984. The fin whale, *Balaenoptera physalus*. *Mar. Fisheries Rev.* 46: 20-24.
Mitchell, E. 1974. Present status of Northwest Atlantic fin and other whale stocks. Pages 109-169. *In:* W. E. Schevill (ed), *The whale problem: A status report*. Harvard University Press, Cambridge, Massachusetts, 419 pp.
Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. *Rep. int. Whal. Commn.* Special Issue 16: 27-50.
Palka, D. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. NMFS, Northeast Fisheries Science Center Ref. Doc. 00-07; 29 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543.
Seipt, I. E., P. J. Clapham, C. A. Mayo and M. P. Hawvermale. 1990. Population characteristics of individually identified fin whales, *Balaenoptera physalus*, in Massachusetts Bay. *Fish. Bull., U.S.* 88(2): 271-278
Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop, April 3-5, 1996, Seattle, Washington. NOAA Technical Memorandum NMFS-OPR-12. U.S. Dept. of Commerce, Washington, DC. 93 pp.
Watkins, W.A., M.A. Daher, G.M. Reppucci, J.E. George, D.L. Martin, N.A. DiMarzio and D.P. Gannon. 2000. Seasonality and distribution of whale calls in the North Pacific. *Oceanography* 13: 62-67.

SEI WHALE (*Balaenoptera borealis*): Nova Scotia Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Indications are that, at least during the feeding season, a major portion of the Northwest Atlantic sei whale population is centered in northerly waters, perhaps on the Scotian Shelf (Mitchell and Chapman 1977). The southern portion of the species' range during spring and summer includes the northern portions of the US Atlantic Exclusive Economic Zone (EEZ) — the Gulf of Maine and Georges Bank. The period of greatest abundance there is in spring, with sightings concentrated along the eastern margin of Georges Bank and into the Northeast Channel area, and along the southwestern edge of Georges Bank in the area of Hydrographer Canyon (CETAP 1982). NMFS aerial surveys in 1999, 2000 and 2001 found concentrations of sei and right whales along the Northern Edge of Georges Bank in the spring. The sei whale is often found in the deeper waters characteristic of the continental shelf edge region (Hain *et al*. 1985), and NMFS aerial surveys found substantial numbers of sei whales in this region, south of Nantucket, in the spring of 2001. Similarly, Mitchell (1975) reported that sei whales off Nova Scotia were often distributed closer to the 2,000 m depth contour than were fin whales.

This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters. Although known to take piscine prey, sei whales (like right whales) are largely planktivorous, feeding primarily on euphausiids and copepods. In years of reduced predation on copepods by other predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the Great South Channel (in 1987 and 1989) and Stellwagen Bank (in 1986) areas (R.D. Kenney, pers. comm.; Payne *et al*. 1990). An influx of sei whales into the southern Gulf of Maine occurred in the summer of 1986 (Schilling *et al*. 1993). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide.

Based on analysis of records from the Blandford, Nova Scotia, whaling station, where 825 sei whales were taken between 1965 and 1972, Mitchell (1975) described two "runs" of sei whales, in June-July and in September-October. He speculated that the sei whale population migrates from south of Cape Cod and along the coast of eastern Canada in June and July, and returns on a southward migration again in September and October; however, such a migration remains unverified.

Mitchell and Chapman (1977) reviewed the sparse evidence on stock identity of northwest Atlantic sei whales, and suggested two stocks — a Nova Scotia stock and a Labrador Sea stock. The range of the Nova Scotia stock includes the continental shelf waters of the northeastern USA, and extends northeastward to south of Newfoundland. The Scientific Committee of the IWC, while adopting these general boundaries, noted that the stock identity of sei whales (and indeed all North Atlantic whales) was a major research problem (Donovan 1991). In the absence of evidence to the contrary, the proposed IWC stock definition is provisionally adopted, and the "Nova Scotia stock" is used here as the management unit for this stock assessment. The IWC boundaries for this stock are from the USA east coast to Cape Breton, Nova Scotia, thence east to longitude 42° W.

POPULATION SIZE

The total number of sei whales in the US Atlantic EEZ is unknown. However, two abundance estimates are available for portions of the sei whale habitat ~~(Table 1)~~: from Nova Scotia during the 1970's, and in the US Atlantic EEZ during the springs of 1979-1981.

Mitchell and Chapman (1977), based on tag-recapture data, estimated the Nova Scotia, Canada, stock to contain between 1,393 and 2,248 sei whales ~~(Table 1)~~. Based on census data, they estimated a minimum Nova Scotian population of 870 sei whales.

An abundance of ~~253~~280 sei whales ~~(CV=0.63)~~ 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 data collected during the spring when the greatest proportion of the population off the northeast USA coast appeared in the study area. This estimate does not include a correction for dive-time or g(0), the probability of detecting an animal group on the track line. The CETAP report suggested, however, that correcting the estimated abundance for dive time would increase the estimate to approximately the same as Mitchell and Chapman's (1977) tag-recapture estimate. This estimate is ~~almost~~more than 20 years out of date and thus almost certainly does not reflect the current true population size; in addition, the estimate has a high degree of uncertainty (i.e., it has a large CV), and it was estimated just after cessation of extensive foreign fishing operations in the region. There are no recent abundance estimates for the sei whale.

~~Table 1. Summary of abundance estimates for the Nova Scotia stock of the sei whale. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).~~

~~Month/YearAreaN_{best}CV1966 - 1972Nova Scotia, Canada 1,393 to 2,248None reportedspring 1978-82Cape Hatteras, NC to Nova Scotia2530.63~~

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). A current minimum population size cannot be estimated because there are no current abundance estimates (within the last 10 years).

Current Population Trend

There are insufficient data to determine the population trends for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because the sei whale is listed as endangered under the Endangered Species Act (ESA). PBR for the Nova Scotia stock of the sei whale is unknown because the minimum population size is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There ~~are few if any data on fishery interactions or human impacts. There~~ was no reported fishery-related mortality or serious injury to sei whales in fisheries observed by NMFS during ~~1994-1998. There are no reports of mortality, entanglement, or injury in the NEFSC or NE Regional Office databases; however, there is a report of a ship strike. The New England Aquarium documented~~ 1997-2001. A review of NMFS stranding and entanglement records from 1997 through 2001 yielded an average of 0.2 human-caused mortalities per year as a result of one confirmed record from May 2, 2001 when a sei whale carcass ~~hung~~ was recovered in New York harbor after it slid off the bow of an arriving ship. Freshness of carcass and hemorrhaging around the dorsal impact area indicated the strike was pre-mortem. The only other NMFS record of a human-caused sei whale mortality was from November 17, 1994, when a sei whale carcass was observed on the bow of a container ship as it docked in Boston ~~on November 17~~, ~~1994~~ Massachusetts.

Fishery Information

There have been no reported entanglements or other interactions between sei whales and commercial fishing activities; therefore there are no descriptions of fisheries.

STATUS OF STOCK

The status of this stock relative to OSP in the US Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine the population trends for sei whales. The total level of human-caused mortality and serious injury is unknown, but the rarity of mortality reports for this species suggests that this level is insignificant and approaching a zero mortality and serious injury rate. This is a strategic stock because the sei whale is listed as an endangered species under the ESA. A Recovery Plan for sei whales has been written and is awaiting legal clearance.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Technical Memorandum NMFS-OPR-6. U.S. Department of Commerce, Washington, DC. 73 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Donovan, G. P. 1991. A review of IWC stock boundaries. *Rep. int. Whal. Commn.* Special Issue 13: 39-68.

Hain, J. H. W., M. A. M. Hyman, R. D. Kenney and H. E. Winn. 1985. The role of cetaceans in the shelf-edge region of the northeastern United States. *Mar. Fish. Rev.* 47(1): 13-17.

Mitchell, E. 1975. Preliminary report on Nova Scotia fishery for sei whales (*Balaenoptera borealis*). *Rep. int. Whal. Commn.* 25: 218-225.

Mitchell, E. and D. G. Chapman. 1977. Preliminary assessment of stocks of northwest Atlantic sei whales (*Balaenoptera borealis*). *Rep. int. Whal. Commn.* Special Issue 1: 117-120.

Payne, P. M., D. N. Wiley, S. B. Young, S. Pittman, P. J. Clapham and J. W. Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. *Fish. Bull., U.S.* 88: 687-696.

Schilling, M. R., I. Seipt, M. T. Weinrich, S. E. Frohock, A. E. Kuhlberg and P. J. Clapham. 1993. Behavior of individually identified sei whales, *Balaenoptera borealis*, during an episodic influx into the southern Gulf of Maine in 1986. *Fish. Bull., U.S.* 90(4): 749-755.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop, April 3-5, 1996, Seattle, Washington. NOAA Technical Memorandum NMFS-OPR-12. U.S. Dept. of Commerce, Washington, DC. 93 pp.

MINKE WHALE (*Balaenoptera acutorostrata*): Canadian East Coast Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Minke whales have a cosmopolitan distribution in polar, temperate and tropical waters. In the North Atlantic there are four recognized populations — Canadian east coast, west Greenland, central North Atlantic, and northeastern North Atlantic (Donovan 1991). These four population divisions were defined by examining segregation by sex and length, catch distributions, sightings, marking data and pre-existing ICES boundaries; however, there are very few data from the Canadian east coast population.

Minke whales off the eastern coast of the United States are considered to be part of the Canadian east coast stock, which inhabits the area from the eastern half of the Davis Strait (~~out to~~ 45°W) to the ~~and and south to the~~ Gulf of Mexico. The relationship between this and the other three stocks is uncertain. It is also uncertain if there are separate stocks within the Canadian east coast stock.

The minke whale is common and widely distributed within the USA Atlantic Exclusive Economic Zone (EEZ) (CETAP 1982). There appears to be a strong seasonal component to minke whale distribution. Spring and summer are times of relatively widespread and common occurrence, and during this time they are most abundant in New England waters. During fall in New England waters, there are fewer minke whales, while during winter, the species appears to be largely absent. Like most other baleen whales, the minke whale generally occupies the continental shelf proper, rather than the continental shelf edge region. Records summarized by Mitchell (1991) hint at a possible winter distribution in the West Indies and in mid-ocean south and east of Bermuda. As with several other cetacean species, the possibility of a deep-ocean component to distribution exists but remains unconfirmed.

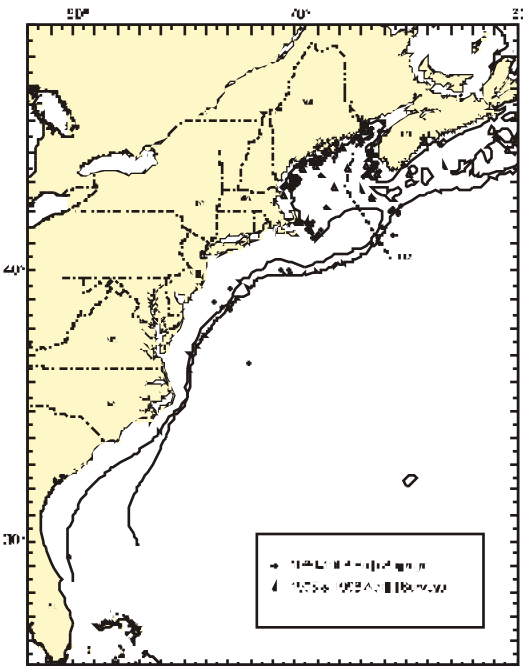

Figure 1. *Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1990-1998. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

The total number of minke whales in the Canadian East Coast population is unknown. However, seven estimates are available for portions of the habitat — a 1978-1982 estimate, a shipboard survey estimate from the summers of 1991 and 1992, a shipboard estimate from June-July 1993, an estimate made from a combination of shipboard and aerial surveys conducted during July to September 1995, an aerial survey estimate of the entire Gulf of St. Lawrence conducted in August to September 1995, an aerial survey estimate from the northern Gulf of St. Lawrence conducted during July and August 1996, and an aerial/shipboard survey conducted from Georges Bank to the mouth of the Gulf of St. Lawrence during July and August 1999 (Table 1; Figure 1).

An abundance of 320 minke whales (CV=0.23) 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 (CETAP 1982).

An abundance of 2,650 (CV=0.31) minke whales was estimated from two shipboard line-transect surveys conducted during July to September 1991 and 1992 in the northern Gulf of Maine-lower Bay of Fundy region (Table 1). This abundance estimate~~population size~~ is a weighted-average of the 1991 and 1992 estimates, where each annual estimate was weighted by the inverse of its variance, using methods as described in Palka (1995).

An abundance of 330 minke whales (CV=0.66) was estimated from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Table 1; Anon. 1993).

An abundance of 2,790 (CV=0.32) minke whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; Palka *et al*. in review). Total track line length was 32,600 km. The ships covered waters between the 50 and 1000 fathom depth contour isobaths, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the mid-Atlantic from the coastline to the 50 fathom depth contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom depth contour line. Data collection and analysis methods were described in Palka (1996).

Kingsley and Reeves (1998) estimated there were 1,020 (CV=0.27) minke whales in the entire Gulf of St. Lawrence in 1995 and 620 (CV=0.52) in the northern Gulf of St. Lawrence in 1996. During the 1995 survey, 8,427 km of track lines were flown in an area of 221,949 km^2 during August and September. During the 1996 survey, 3,993 km of track lines were flown in an area of 94,665 km^2 during July and August. Data were analyzed using Quenouille's jackknife bias reduction procedure on line-transect methods that model the left truncated sighting curve. These estimates were uncorrected for visibility biases such as *g(0)*, the probability of detecting a group on the track line.

An abundance of 2,998 (CV=0.19) minke whales was estimated from a July to August 1999 sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence (Table 1; D. Palka, pers. comm.). Total track line length was 8,212 km. Using methods s~~S~~imilar to that used in the above 1995 Virginia to Gulf of St. Lawrence survey, shipboard data were analyzed using the modified direct duplicate method that 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).

The best available current abundance estimate for minke whales is the sum of the 1999 Georges Bank to Gulf of St. Lawrence survey (2,998 (CV=0.19)) and the 1995 Gulf of St. Lawrence survey (1,020 (CV=0.27)), 4,018 (CV=0.16), because these surveys are recent and provided the most complete coverage of the known habitat.

Table 1. Summary of abundance estimates for Canadian East Coast minke whales. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Row Number	Month/Year	Area	N_{best}	CV
1	Jul -Sep 1991-92	No. Gulf of Maine and Bay of Fundy	2,650	0.31
2	Jun-Jul 1993	Georges Bank to Scotian shelf, shelf edge only	330	0.66
3	Jul-Sep 1995	Virginia to mouth of Gulf of St. Lawrence	2,790	0.32
4	Aug-Sep 1995	Gulf of St. Lawrence	1,020	0.27
5	Jul-Sep 1995	Virginia to Gulf of St. Lawrence (SUM OF ROWS 3 and 4)	3,810	0.25
6	Jul-Aug 1996	northern Gulf of St. Lawrence	620	0.52
7	July-Aug 1999	Georges Bank to mouth of Gulf of St. Lawrence	2,998	0.19
8	Aug-Sep 1995 + July-Aug 1999	Georges Bank to Gulf of St. Lawrence (SUM OF ROWS 4 AND 7)	4,018	0.16

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 minke whales is 4,018 (CV=0.16). The minimum population estimate for the Canadian East Coast minke whale is 3,515 (CV=0.16).

Current Population Trend

There are insufficient data to determine population trends for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: females mature when 6-8 years old; pregnancy rates are approximately 0.86 to 0.93; thus, the calving interval is between 1 and 2 years; calves are probably born during October to March, after 10 to 11 months gestation; nursing lasts for less than 6 months; maximum ages are not known, but for Southern Hemisphere minke whales the maximum age appears to be about 50 years (Katona *et al*. 1993; IWC 1991).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 3,515 (CV=0.16). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the Canadian east coast minke whale is 35.

ANNUAL HUMAN-CAUSED MORTALITY AND INJURY

Recent minke whale takes have been observed or attributed to the Atlantic tuna purse seine, Gulf of Maine and mid-Atlantic lobster trap/pot, mid-Atlantic coastal gillnet, and unknown fisheries; though all takes have not resulted in mortalities (Tables 2-5).

Data to estimate the mortality and serious injury of minke whales come from the USA Sea Sampling Program and from records of strandings and entanglements in USA waters. Estimates using the Sea Sampling Program data are discussed by fishery under the Fishery Information section below (Table 2). Strandings and entanglement records are discussed under the lobster trap fishery, mid-Atlantic coastal gillnet fishery, and "Unknown Fisheries" within the Fishery Information section and under the Other Mortality section (Tables 3 and 4). Ship strike mortalities and serious injuries are discussed under the Other Mortality section. For the purposes of this report, only those strandings and entanglement records considered confirmed human-caused mortalities or serious injuries are discussed.

During 199~~6~~7 to 200~~0~~1, the USA total annual estimated average human-caused mortality was ~~2~~3.6 minke whales per year. This is derived from three components: 0 minke whales per year (CV=0.0) from USA fisheries using observer data, ~~2~~3.4 minke whales per year from USA fisheries using strandings and entanglement data, and 0.2 minke whales per year from ship strikes. During 199~~6~~7 to 200~~0~~1, there were no confirmed mortalities or serious injuries in Canadian waters as reported by the various, small scale stranding and observer data collection programs in Atlantic Canada.

Fishery Information

EARLIER INTERACTIONS

Little information is available about fishery interactions that took place before the 1990's. Read (1994) reported that a minke whale was found dead in a Rhode Island fish trap in 1976.

Distant-water Fleet

Prior to 1977, there was no documentation of marine mammal bycatch in the distant-water fleet (DWF) activities off the northeast coast of the USA. With implementation of the Magnuson Fisheries Conservation and Management Act in that year, an observer program was established which recorded fishery data and information on incidental bycatch of marine mammals. A minke whale was caught and released alive in the Japanese tuna longline fishery in 3,000 m of water, south of Lydonia Canyon on Georges Bank, in September 1986 (Waring *et al.* 1990). In 1982, there were 112 different foreign vessels; 16%, or 18, were Japanese tuna longline vessels operating along the USA east coast. This was the first year that the Northeast Regional Observer Program assumed responsibility for observer coverage of the longline vessels. Between 1983 and 1988, the numbers of Japanese longline vessels operating within the US Atlantic EEZ each year were 3, 5, 7, 6, 8, and 8, respectively. Observer coverage was 100%.

Northeast Sink Gillnet

Two minke whales were observed taken in the Northeast sink gillnet fishery between 1989 and the present. The take in July 1991, south of Penobscot Bay, Maine resulted in a mortality, and the take in October 1992, off the coast of New Hampshire near Jeffreys Ledge was released alive. There were approximately 349 vessels (full and part time) in the Northeast sink gillnet fishery in 1993 (Walden 1996) and 301 full and part time vessels in 1998. Observer coverage as a percentage of trips has been 1%, 6%, 7%, 5%, 7%, 5%, 4%, 6%, 5%, 6%, 6% and ~~6%~~4% for years 1990 to 200~~0~~1, respectively. Because no mortalities have been observed since 1991, the annual estimated average Northeast sink gillnet fishery-related mortality for minke whales is zero.

Herring Weir

A minke whale got trapped and was released alive from a herring weir off northern Maine in 1990. In USA and Canadian waters the herring weir fishery occurred from May to September each year along the southwestern shore of the Bay of Fundy, and was scattered along the coasts of western Nova Scotia and northern Maine. In 1990 there were 56 active weirs in Maine (Read 1994). According to state officials, in 1998, the number of weirs in Maine waters dropped to nearly nothing due to the limited herring market (Jean Chenoweth, pers. comm.) and in 2000 only 11 weirs were built (Molyneaux 2000). The number of active weirs in the USA is unknown. It is also unknown if the active weirs incidentally take any marine mammals.

Pelagic Drift Gillnet

In 1996 and 1997, 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). Four minke whale mortalities were observed in the Atlantic pelagic drift gillnet fishery during 1995. 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 to 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. 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. 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 was 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 for 1989 to 1994, 4.5 (0) for 1995, 0 for 1996 (Bisack 1997) and 0 for 1998. The fishery was closed during 1997. Estimated average annual mortality and serious injury related to this fishery during 1994 to 1996, and 1998 was 1.1 minke whales (CV=0.0). There is no current mortality related to this fishery because the fishery closed in 1999.

USA

Atlantic Tuna Purse Seine

In an Atlantic tuna purse seine off Stellwagen Bank, one minke whale was reported caught and released uninjured in 1991 (D. Beach, NMFS NE Regional Office, pers. comm.) and in 1996. The minke caught during 1991 escaped after a crew member cut the rope that was wrapped around the tail. The minke whale caught during 1996 escaped by diving beneath the net (Table 2). The tuna purse seine fishery occurring between Cape Hatteras and Cape Cod is directed at small and medium bluefin and skipjack for the canning industry, while the fishery north of Cape Cod is directed at large medium and giant bluefin tuna (NMFS 1995). These two fisheries are entirely separate from other Atlantic tuna purse seine fisheries. Spotter aircraft were used to locate fish schools. The official start date, set by regulation, was August 15. Individual vessel quotas (IVQs) and a limited access system prevent a derby fishery situation. Catch rates for large mediums and giant tuna are high and consequently, the season usually only lasts a few weeks. The 1996 regulations allocated 250 MT (5 IVQs) with a minimum of 90% giants and 10% large mediums.

Limited observer data are available for the Atlantic tuna purse seine fishery. Out of 45 total trips made in 1996, 43 trips (95.6%) were observed. Forty-four sets were made on the 43 observed trips and all sets were observed. A total of 136 days were covered. No trips were observed during 1997 through 1999. Two trips (seven hauls) were observed in October 2000 in the Great South Channel region. Four trips were observed in September 2001. No marine mammals were observed taken during these trips. If there are no minke whale takes during 2002, then this section will be put into the "Earlier Interactions" section, because there we~~re~~ill be no takes observed within the ~~most recent~~previous five years.

Gulf of Maine and mid-Atlantic Lobster Trap/Pot Fishery

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported seven minke whale mortalities and serious injuries that were attributed to the lobster fishery during 1990 to 1994; 1 in 1990 (may be serious injury), 2 in 1991 (one mortality and one serious injury), 2 in 1992 (both mortalities), 1 in 1993 (serious injury) and 1 in 1994 (mortality) (1997 List of Fisheries 62FR33, January 2, 1997). The one confirmed minke whale mortality during 1995 was attributed to the lobster fishery (Tables 3 and 4). No confirmed mortalities or serious injuries of minke whales occurred in 1996. From the four confirmed 1997 records, one minke whale mortality was attributed to the lobster trap fishery.~~ No fishery could be attributed to the other three 1997 minke mortalities (see unknown fisheries).~~ No minke whale mortalities were attributed to ~~a fishery for 1998. None of the five confirmed minke whale mortalities in 1999, and neither of the two confirmed mortalities or serious injuries from 2000 were attributed to this fishery~~this fishery for other years.

There are three distinctly identified stock areas for the American lobster: 1) Gulf of Maine, 2) south of Cape Cod to Long Island Sound, and 3) Georges Bank and south to Cape Hatteras. In 1997, there were 3,431 vessels holding licenses to harvest lobsters in federal waters, 2,674 vessels licensed to use lobster pot gear in state waters, 675 vessels licensed to use bottom trawls and approximately 100 licenses to use dredge gear to harvest lobsters. In 2000, there were 7,539 vessels from Maine to North Carolina holding licenses. Lobsters are taken primarily by traps, with about 2-3% of the harvest being taken by mobile gear (trawlers and dredges). About 80% of lobsters were harvested from state waters. The offshore fishery in federal waters has developed in the past 10 to 15 years, largely due to technological improvements in equipment and lower competition in the offshore areas. In January 1997, NMFS changed the classification of the Gulf of Maine and USA mid-Atlantic lobster pot fisheries from Category III to Category I (1997 List of Fisheries 62FR33, January 2, 1997) based on examination of 1990 to 1994 stranding and entanglement records of large whales (including right, humpback and minke whales). This fishery is operating under regulations from the Large Whale Take Reduction Plan (July 22, 1997; 62 FR 39157) and the federal American Lobster fishery plan (December 6, 1999; 64 FR 68228). Annual mortalities due to this fishery, as determined from strandings and entanglement records that have been audited, were 1 in 1991, 2 in 1992, 1 in 1994, 1 in 1995, 0 in 1996, 1 in 1997 and 0 in 1998 to 200~~0~~1. Estimated average annual mortality related to this fishery during 199~~6~~7 to 200~~0~~1 was 0.2 minke whales per year (Table 3).

Mid-Atlantic Coastal Gillnet

One minke whale, reported in the strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, was taken in a 6-inch gill net on 06 July 1998 off Long Island, New York (Tables 3 and 4). This take ~~is being~~was assigned to the mid-Atlantic coastal gillnet fishery. No minke whales have been taken from this fishery during observed trips in 1993 to 200~~0~~1. In July 1993, an observer program was initiated in the USA Atlantic coastal gillnet fishery by the NEFSC Sea Sampling program. Twenty trips were observed during 1993. During 1994 and 1995, 221 and 382 trips were observed, respectively. This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species.~~, s~~ Some of these vessels operate right off the beach, some use~~ing~~ drift nets and others use~~ing~~ sink nets. During 1998, it was estimated that 302 full- and part-time sink gillnet vessels and an undetermined number of drift gillnet vessels participated in this fishery. This is the number of unique vessels in the commercial landings database (Weighout) that reported catch from fisheries during 1998 from the states of Connecticut to North Carolina. This does not include a small percentage of records where the vessel number was missing. Observer coverage, expressed as percent of tons of fish landed, was 5%, 4%, 3%, 5%, 2%, 2% and 2% for 1995 to 200~~0~~1, respectively. Observed fishing effort was concentrated off New Jersey and scattered between Delaware and North Carolina from the beach to 50 miles off the beach.

Annual mortalities due to this fishery, as determined from strandings and entanglement records were 0 in 1991, 1992, 1994 to 1997, 1 in 1998 and 0 in 1999 to 200~~0~~1. Estimated average annual mortality related to this fishery during 199~~6~~7 to 200~~0~~1 was 0.2 minke whales per year (Tables 3 and 4).

Unknown Fisheries

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, included 36 records of minke whales within USA waters for 1975-1992. The gear included unspecified fishing net, unspecified cable or line, fish trap, weirs, seines, gillnets, and lobster gear. A review of these records is not complete. One confirmed entanglement was an immature female minke whale, entangled with line around the tail stock, that came ashore on the Jacksonville, Florida jetty on 31 January 1990 (R. Bonde, USFWS, Gainesville, FL, pers. comm.).

The audited NE Regional Office/NMFS entanglement/stranding database for 1995 to ~~1999~~2001 contains ~~33~~43 records of minke whales, of which the confirmed mortalities and serious injuries are reported in Table 4. Mortalities (and serious injuries) that were likely a result of a fishery interaction with an unknown fishery include 3 (0) in 1997, ~~5~~3 (0) in 1999, ~~2~~1 (1) in 2000, 3 (2) in 2001, and 0 in other years. The examination of the minke entanglement records from 1997 indicate that 4 out of 4 confirmed records of mortality are likely a result of fishery interactions, one attributed to the lobster pot fishery (see above), and three not attributed to any particular fishery because the reports do not contain the necessary details. Of the 5 mortalities in 1999, 2 were attributed to an unknown trawl fishery and 3 to some other fishery. One of the interactions with an unknown fishery in 2000 was a mortality and one was a serious injury (Tables 3 and 4). In 2001, of the 5 confirmed fishery interactions, 3 interactions were mortalities in an unknown fishery and 2 were serious injuries in an unknown fishery.

In general, an entangled or stranded cetacean could be an animal that is part of an expanded bycatch estimate from an observed fishery and thus it is not possible to know if an entangled or stranded animal is an additional mortality. During 1997 to ~~1999~~2001, there were no minke whales observed taken in any fishery that participated in the Sea Sampling Program, therefore, the strandings where mortality was due to a fishery interaction can be added into the human-caused mortality estimate. During 199~~6~~7 to 200~~0~~1, as determined from strandings and entanglement records, the estimated average annual mortality is 0.4 minke whales per year in unknown trawl fisheries, and ~~1~~2.6 minke whales per year~~-~~ in unknown fisheries (Table 3).

CANADA

In Canadian waters, information about minke whale interactions with fishing gear is not well quantified or recorded, though some records are available. Read (1994) reported interactions between minke whales and gillnets in Newfoundland and Labrador, cod traps in Newfoundland, and herring weirs in the Bay of Fundy. Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on between 25% and 40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. During 1991 through 1996, no minke whales were observed taken.

Herring Weirs

During 1980 to~~and~~ 1990, 15 of 17 minke whales were released alive from herring weirs in the Bay of Fundy. Due to the formation of a cooperative program between Canadian fishermen and biologists it is expected that now most minke whales will be able to be released alive.

During January 1991 to September 2002, 26 minke whales were trapped in herring weirs in the Bay of Fundy. Of these 26, 1 died (H. Koopman, pers. comm.) and ~~During 1999 to 2000,~~several (number unknown) ~~minke whales~~ were released alive and unharmed~~, none died~~ (A. Westgate, pers. comm.).

In USA and Canadian waters, the herring weir fishery occurres~~d~~ from May to ~~September~~October ~~each year~~ along the southwestern shore of the Bay of Fundy, and is~~was~~ scattered along the coasts of western Nova Scotia and northern Maine. In 1990 there were 180 active weirs in western Bay of Fundy (Read 1994). According to Canadian Dept. of Fisheries and Oceans (DFO) officials, for 1998, there were 225 licenses for herring weirs on the New Brunswick and Nova Scotia sides of the Bay of Fundy (60 from Grand Manan Island, 95 from Deer and Campobello Islands, 30 from Passamaquoddy Bay, 35 from East Charlotte area, and 5 from the Saint John area). The number of licenses has been fairly consistent since 1985 (Ed Trippel, pers. comm.), but the number of active weirs is less than the number of licenses, and the number has been decreasing every year, primarily due to competition with salmon mariculture sites (A. Read, pers. comm.). Around Grand Manan, there were 25 active weirs in 2001, and 21 in 2002 (H. Koopman, pers. comm). But numbers of weirs for the Nova Scotia shore, Campobello, Deer and the Wolves Islands, or the New Brunswick mainland shore are unknown (H. Koopman, pers. comm.).

Other Fisheries

Six minke whales were reported entangled during 1989 in the now non-operational groundfish gillnet fishery in Newfoundland and Labrador (Read 1994). One of these animals escaped and was still towing gear, the remaining 5 animals died.

Salmon gillnets in Canada, now no longer being used, had taken a few minke whales. In Newfoundland in 1979, one minke whale died in a salmon net. In Newfoundland and Labrador, between 1979 and 1990, it was estimated that 15% of the Canadian minke whale takes were in salmon gillnets. A total of 124 minke whale interactions were documented in cod traps, groundfish gillnets, salmon gillnets, other gillnets and other traps. This fishery ended in 1993 as a result of an agreement between the fishermen and North Atlantic Salmon Fund (Read 1994).

Five minke whales were entrapped and died in Newfoundland cod traps during 1989. The cod trap fishery in Newfoundland closed in 1993 due to the depleted groundfish resources (Read 1994).

Table 2. Summary of minke whales (*Balaenoptera acutorostrata*) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured).

Fishery	Years	Ratio	Injured	Uninjured
Tuna purse seine	~~96-00~~97-01	~~0/0,~~ NA[~~2~~1], NA[~~2~~1], ~~NA[2]~~NA[1], 0/0, 0/0	~~0,~~ NA[~~2~~1], NA[~~2~~1], ~~NA[2]~~NA[1], 0[2], 0[3]	~~1[1]~~NA[1], NA[~~2~~1], NA[~~2~~1], ~~NA[2]~~0[2], 0[3]

NA=Not Available.

1 ~~The minke whale escaped by diving beneath the net.~~

~~2~~ No observer coverage during 1997 through 1999.

~~3~~2 Two trips were observed during October 2000.

3 Four trips were observed during September 200~~0~~1.

Table 3. From strandings and entanglement data, summary of confirmed incidental ~~mortality~~mortalities and serious injuries of minke whales (*Balaenoptera acutorostrata*) by commercial fishery: includes years sampled (Years), number of vessels active within the fishery (Vessels), type of data used (Data Type), mortalities and serious injuries assigned to this fishery (Assigned Mortality), and mean annual mortality and serious injuries. See Table 4 for details.

Fishery	Years	Vessels	Data Type [1]	Assigned Mortality	Mean Annual Mortality
GOM and mid-Atlantic Lobster Trap/Pot	~~96-00~~97-01	1997=6880 2000=7539 licenses[2]	Entanglement & Strandings	~~0~~1, ~~1~~0, 0, 0, 0	0.2 ~~(0)~~
mid-Atlantic Coastal Gillnet	~~96-00~~97-01	1998=302[3]	Entanglement & Strandings	0, ~~0~~1, ~~1~~0, 0, 0	0.2
Unknown Trawl	~~96-00~~97-01	NA	Entanglement & Strandings	0, 0, ~~0~~2, ~~2~~0, 0	0.4
Unknown Fisheries	~~96-00~~97-01	NA	Entanglement & Strandings	~~0,~~ 3, 0, 3, 2, 5	~~1~~2.6 ~~(0)~~
TOTAL					~~2~~3.4 (~~0~~unk)

NA=Not Available.

1 Data from records in the entanglement and strandings data base maintained by the New England Aquarium and the Northeast Regional Office/NMFS (Entanglement and Strandings).

2 Number of vessels licensed to harvest lobsters in federal and state waters, with lobster traps/pots, bottom trawls, and dredge gear.

3 Number of sink gillnet vessels.

Table 4. Summarized records of mortality and serious injury likely to result in mortality. Canadian East Coast stock of minke whales, January 1994 - December ~~1999~~2001. This listing includes only confirmed 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	Unk/ uncertain	
~~7/2/94~~	~~mortality~~	~~unk sex and size~~	~~off NH~~		~~P~~		~~Lobster fishery. Lobster lines (3-pair traps involved; line through mouth; one line around lower jaw; chafing on tail; whale brought up dead with traps.~~
~~8/23/95~~	~~mortality~~	~~unk sex and size~~	~~near Swan Island, ME~~		~~P~~		~~Lobster fishery. Entangled in inshore lobster gear.~~

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary			Notes
				Ship strike	Entang./ Fsh.inter	Unk/ uncertain	
5/15/97	mortality	female 5.5 m (est)	Gloucester, MA (42°36' N 70°38' W)		P		Unknown fishery. Deep lacerations around tail stock, abrasions around flukes and mouth
5/16/97	mortality	female 5.5 m (est)	Rockport, MA (42°40' N 70°35' W)		P		Unknown fishery. Abrasions around flukes; feeding prior to entanglement
8/14/97	mortality	female 2.8 m	Jewell Island, ME (43°39' N 70°02' W)		P		Unknown fishery. Fresh lacerations on flukes and pectoral fins
8/30/97	mortality	female 8 m (est)	Cape Small, ME (43°40' N 69°57' W)		P		Lobster fishery. Observed entangled in lobster gear by ME Marine Patrol
6/24/98	mortality	male 3.4 m	Long Beach, NY (40° 34' N 73° 42' W)		P		mid-Atlantic coastal gillnet fishery. Alive initially, then died in a 6-inch mesh gillnet.
12/12/98	mortality	unk sex and size	Cape Cod Bay, MA	P			Body of whale seen in wake of a whale watching vessel.
5/9/99	mortality	female 5.6 m	Cape Lookout Bight (34° 61'N 76° 54'W)		P		Unknown fishery. Fresh open wounds around fluke and line marks from pectoral fins through mouth.
6/16/99	mortality	female 6.9 m	Orleans, MA (41° 48'N 65° 56'W)		P		Unknown fishery. Extensive rope markings with hemorrhaging.
7/3/99	mortality	unk sex and size	Sakonnet River, RI (41°48'N 71°12'W)		P		Trawl fishery. 4.5 inch stretched mesh driven into rostrum.
8/2/99	mortality	unk sex and size	Point Judith Light, RI (41°23'N 71°28'W)		P		Trawl fishery. 6 inch stretched mesh tightly wrapped around rostrum.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary			Notes
				Ship strike	Entang./ Fsh.inter	Unk/ uncertain	
10/2/99	mortality	female 7.2 m	Provincetown, MA (42°03'N 70°21'W)		P		Unknown fishery. Rope marks on left gape of mouth, left pectoral fin, caudal peduncle, and dorsal and ventral surfaces of fluke blades.
8/11/00	serious injury	unk sex and size	Port Clyde, ME (43°55'N 69°11'W)		P		Unknown fishery. Dark line with several bullet buoys. Unusual minke behavior - whale probably anchored.
8/26/00	mortality	unk sex and size	Rockland ME (44°05'N 69°01'W)		P		Unknown fishery. Very fresh carcass with fresh entanglement wounds on tail stock.
6/13/01	serious injury	unk sex, 7.6 m (est)	Cape Cod (42°06'N 70°08'W0		P		Unknown fishery. Animal free-swimming with tangle of line behind blowhole, trailing line on left side.
7/27/01	mortality	female, 3.9 m (est)	Whale Rock, RI (41°26'N 71°25'W)		P		Unknown fishery. Line wrapped behind head and dorsal fin.
8/17/01	mortality	male, 3.9 m	Middletown, RI (41°28'N 71°15'W)		P		Unknown fishery. Severe rope entanglement around mouth and rostrum caused malnutrition and infection.
10/20/01	serious injury	unk sex, 6.1 m (est)	Stellwagen Bank (42°11'N 70°10'W)		P		Unknown fishery. Line with high flyer attached.
12/13/01	mortality	unk sex, 7 m (est)	Massachusetts Bay (42° 21'N 70°43'W)		P		Unknown fishery. Pictures show evidence of fairly fresh entanglement marks on tail stock and across tail flukes.

Other Mortality

Minke whales have been and are still being hunted in the North Atlantic. From the Canadian East Coast population, documented whaling occurred from 1948 to 1972 with a total kill of 1,103 animals (IWC 1992). Animals from other North Atlantic populations are presently still being harvested at low levels.

USA

Minke whales inhabit coastal waters during much of the year and are subject to collision with vessels. According to the NMFS/NER marine mammal entanglement and stranding database, on 7 July 1974, a necropsy of a minke whale suggested a vessel collision occurred; on 15 March 1992, a juvenile female minke whale with propeller scars was found floating east of the St. Johns Channel entrance (R. Bonde, USFWS, Gainesville, FL, pers. comm.); and on 15 July 1996 the captain of a vessel reported they hit a minke whale offshore of Massachusetts. After reviewing this record, it was concluded the animal struck was not a serious injury or mortality. On 12 December 1998, a minke whale was struck and presumed killed by a whale watching vessel in Cape Cod Bay off Massachusetts.

During 199~~6~~7 to 200~~0~~1, one minke whale was confirmed struck by a ship, thus, there is an annual average of 0.2 minke whales per year struck by ships (Table 4).

CANADA

Whales and dolphins stranded between 1991 and 1996 on the coast of Nova Scotia were documented by the Nova Scotia Stranding Network (Hooker *et al*. 1997). Strandings on the beaches of Sable Island were documented by researchers with Dept. of Fisheries and Oceans, Canada (Lucas and Hooker 2000). Sable Island is approximately 170 km southeast of mainland Nova Scotia. Lucas and Hooker (2000) report 4 minke whales stranded on Sable Island between 1970 and 1998, 1 in spring 1982, 1 in January 1992, and a mother/calf in December 1998 (Table 5). On the mainland of Nova Scotia, a total of 7 reported minke whales stranded during 1991 to 1996 (Table 5). The 1996 stranded minke whale was released alive off Cape Breton on the Atlantic Ocean side, the rest were found dead. All the minke whales stranded between July and October. One was from the Atlantic Ocean side of Cape Breton, 1 from Minas Basin, 1 was at an unknown location, and the rest stranded in the vicinity of Halifax, Nova Scotia. It is unknown how many of the strandings can be attributed to fishery interactions.

Table 5. Documented number of stranded minke whales along the coast of Nova Scotia and on Sable Island by month and year, according to Hooker *et al*. (1997) and Lucas and Hooker (2000).

Year	Month	Number of strandings	
		Sable Isl.	Nova Scotia
1991	Sept		1
1992	Jan	1	
	July		1
1993	July		1
	Oct		2
1994	Aug		1
1996	July		1
1998	Dec	1	
TOTAL		2	7

STATUS OF STOCK

The status of minke whales, relative to OSP, in the US Atlantic EEZ is unknown. The minke whale is not listed as endangered under the Endangered Species Act (ESA). The total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, ~~can~~cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because estimated fishery-related mortality and serious injury does not exceed PBR and the minke whale is not listed as a threatened or endangered species under the ESA.

REFERENCES

Anon. 1993. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine Mammal Survey. 5 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Bisack, K. D. 1997. Marine mammal bycatch estimates and their sampling distributions in the U.S. New England sink gillnet, pair trawl, Atlantic pelagic drift gillnet and North Atlantic bottom trawl fisheries: 1994 to 1996. Working paper SC/49/SM35 submitted to the IWC Scientific Committee meeting in Bournemouth, UK, Aug/Sept 1997.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

Donovan, G. P. 1991. A review of IWC stock boundaries. *Rep. int Whal. Commn* Special Issue 13: 39-68.

Hooker, S. K., R. W. Baird and M. A. Showell. 1997. Cetacean strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Meeting document SC/49/O5 submitted to the 1997 International Whaling Commission meeting in Bournemouth, UK.

IWC [International Whaling Commission]. 1991. Appendix 11. Biological parameters of North Atlantic minke whales in Annex F Report of the sub-committee on North Atlantic Minke whales. *Rep. int Whal. Commn* 41: 160.

IWC [International Whaling Commission]. 1992. Annex K. Report of the working group on North Atlantic Minke trials. *Rep. int Whal. Commn* 42: 246-251.

Katona, S. K., V. Rough and D. T. Richardson. 1993. *A field guide to whales, porpoises, and seals from Cape Cod to Newfoundland*. Smithsonian Institution Press. Washington D.C. 316 pp.

Kingsley, M.C.S. and R.R. Reeves. 1998. Aerial surveys of cetaceans in the Gulf of St. Lawrence in 1995 and 1996. *Can. J. Zool*. 76:1529-1550.

Lucas, Z. N. and S. K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. *Canadian Field-Naturalist* 114(1): 46-61.

Mitchell, E. D. 1991. Winter records of the minke whale (*Balaenoptera acutorostrata* Lacepede 1804) in the southern North Atlantic. *Rep. int Whal. Commn* 41: 455-457.

Molyneaux, P. 2000. Tradition at stake. *National Fisherman* 80(11): 26-29.

National Marine Fisheries Service (NMFS). 1995. Final environmental impact statement for a regulatory amendment for the western Atlantic bluefin tuna fishery. July 20, 1995.

Northridge, S. 1996. Estimation of cetacean mortality in the U.S. Atlantic swordfish and tuna driftnet and pair trawl fisheries. Final report to the Northeast Fisheries Science Center, Contract No. 40ENNF500160. Available from: NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.

Palka, D. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. NOAA/NMFS/NEFSC Ref. Doc. 00-07; 29 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50. *In*: A. Bjørge and G.P. Donovan (eds.) Biology of the Phocoenids. *Rep. int Whal. Commn* Special Issue 16.

Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. NOAA-NMFS-NEFSC Ref. Doc. 96-04; 37p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543.

Palka, D., G. Waring and D. Potter. (in review). Abundances of cetaceans and sea turtles in the northwest Atlantic during summer 1995 and 1998. *Fish. Bull., U.S.*

Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. *Rep. int Whal. Commn* Special Issue 15: 133-147.

Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS workshop April 3-5, 1996, Seattle, Washington. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Walden, J. 1996. The New England gillnet effort study. NOAA-NMFS-NEFSC Ref. Doc. No. 96-10, 38pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543.

Waring, G. T., P. Gerrior, P. M. Payne, B. L. Parry and J. R. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. *Fish. Bull., U.S.* 88(2): 347-360.