HUMPBACK WHALE (*Megaptera novaeangliae*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

During summer there are at least five geographically distinct humpback whale feeding aggregations occurring between latitudes 42°N to 78°N. These feeding areas are (with approximate number of humpback whales in parenthesis): Gulf of Maine (400); Gulf of St. Lawrence (200); Newfoundland and Labrador (2,500); western Greenland (350); and the Iceland-Denmark strait (up to 2,000) (Katona and Beard 1990). The western North Atlantic stock is considered to be include all humpback whales from these five feeding areas.

Humpback whales from all of the western North Atlantic feeding areas migrate to the Caribbean in winter, where courtship, breeding, and calving occur. The majority (85%) are found on Silver and Navidad Banks off the north coast of the Dominican Republic. The remainder are scattered in Samana Bay (Dominican Republic), along the northwest coast of Puerto Rico, through the Virgin Islands, and along the eastern Antilles chain south to Venezuela (Katona and Beard 1990). Courtship groups on the wintering ground contain whales from different feeding aggregations, so that humpbacks from the western North Atlantic probably interbreed (Katona et al. 1994). Apparently, not all humpback whales from this stock winter in the West Indies, as there are winter reports from Bermuda, the Gulf of Maine, Newfoundland, Greenland, and Norway (Katona et al. 1994)

Clapham et al. (1992) reported a high degree of individual site fidelity, both within and between years, from a long-term study of identified humpback whales in waters off Cape Cod. Some reproductive parameters which have been estimated for humpback whales from this area are discussed below.

An increased number of sightings of young humpback whales in the vicinity of the Chesapeake and Delaware Bays occurred in 1992 (Swingle et al. 1993). Wiley et al. (1995) reported 38 humpback whale stranding records which occurred during 1985-1992 in the U.S. mid-Atlantic and southeastern states. Humpback whale strandings increased, particularly along the Virginia and North Carolina coasts, and most stranded animals were sexually immature. They 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 U.S. (NMFS unpublished data; New England Aquarium unpublished data). Whether the increased sightings represent a distributional change, or are simply due to an increase in sighting effort, is presently unknown.

Feeding is the principal activity of humpback whales in New England waters and their distribution in New England waters has been largely correlated to prey species and abundance, although behavior and bottom topography are factors in foraging strategy (Payne et al. 1986, 1990). Humpback whales are believed to be largely piscivorous when in these waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes dubius*), and other small fishes. Commercial depletion of herring and mackerel led to an increase in sand lance in the southwestern Gulf of Maine in the mid 1970s with a concurrent decrease in humpback whale abundance in the northern Gulf of Maine. Humpback whales were densest over the sandy shoals in the southwestern Gulf of Maine favored by the sand lance during much of the late 1970s and early 1980s, and humpback distribution appeared to have shifted to this area (Payne et al. 1986). An apparent reversal began in the mid 1980s, and herring and mackerel increased as sand lance again decreased (Fogarty et al. 1991). Humpback whale abundance in the northern Gulf of Maine increased dramatically during 1992-93 , along with a major influx of herring (T. Fernald, College of the Atlantic, personal communication). Humpback whales were few in nearshore Massachusetts waters in the 1992-93 summer seasons and more abundant in the offshore waters of Cultivator Shoal and Northeast Peak on Georges Bank, and Jeffreys Ledge — more traditional areas of herring occurrence (D. K. Mattila, Center for Coastal Studies, personal communication).

A major research initiative was begun in early 1992 — the Years of the North Atlantic Humpback (YONAH) Project (Allen et al. 1993). This project is a large-scale, intensive, ocean-wide study of humpback whales throughout their entire North Atlantic range conducted over three years. Photographs for individual identification and biopsy samples for genetic analyses were collected from both summer feeding areas in the northeast and breeding grounds in the West Indies. Data are now being analyzed to determine the current population status and genetic relationships of humpback whales throughout their range.

POPULATION SIZE

A population size of 294 humpback whales (CV = 0.45) was estimated for the waters of the U.S. Atlantic Exclusive Economic Zone, based on an inverse variance weighted pooling of CeTAP (1982) spring and summer data and included a dive-time correction using a scale-up factor of 3.6. However, this estimate may not reflect the current true population size because of the high degree of uncertainty (e.g., large coefficient of variation), the data are over a decade old, and values were estimated just after cessation of extensive foreign fishing operations in the region. Katona et al. (1994), using photo-identification techniques and Bailey's modification of the Chapman capture-recapture method, estimated that the total humpback whale population in the North Atlantic Ocean west of Iceland during the years 1979-1990 averaged 5,543 humpback whales (CV = 0.16).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate of 5,543 whales (CV = 0.16) (Katona et al. 1994) and is 4,848 humpback whales. This is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994).

Current Population Trend

There are insufficient data with which to determine trends. Katona and Beard (1990) suggest an annual rate of increase of 9%; however, the lower 95% confidence level was less than zero. The mean birth rate for identified humpbacks in the southwestern Gulf of Maine during 1979-87 was 8% (CV = 0.25), with no significant inter-annual differences, and the calving interval was 2.35 years (CV = 0.30) (Clapham and Mayo 1990; Clapham 1992). The average age at attainment of sexual maturity for both males and females was five years (Clapham and Mayo 1990; Clapham 1992).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Katona and Beard (1990) suggested an annual rate of increase of 9% for the North Atlantic humpback whale; however, the maximum net productivity rate was assumed to be 0.04 for purposes of this assessment because of the high statistical uncertainty surrounding the estimated annual rate of increase. The value of 0.04 is based on theoretical calculations showing that cetacean populations may not generally grow at rates much greater than 4% given the constraints of their reproductive life history (Anon. 1994).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) was specified as the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.10 because this stock is listed as an endangered species under the Endangered Species Act (ESA). PBR for the western North Atlantic humpback whale stock is 9.7 whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There is an average of four to six entanglements of humpback whales a year in waters of the southern Gulf of Maine and additional reports of ship-collision scars (D. L. DeKing, Center for Coastal Studies, Provincetown, Massachusetts, personal communication). An entanglement database maintained by NMFS NE Regional Office contained 64 records of entangled or injured humpbacks from 1975-1992. Humpbacks also become entangled offshore. On 18 January 1993, a dead juvenile humpback was observed entangled in a swordfish drift-net along the 200 m isobath northeast of Cape Hatteras. Entangled animals are often released, although some dead or injured animals likely go unobserved and unreported. Occasionally, "floaters" are encountered at sea (NMFS unpublished data).

Of 20 dead humpback whales, principally in the mid-Atlantic, where decomposition state did not preclude examination for human impacts, Wiley et al. (1995) reported that six (30%) had major injuries possibly attributable to ship strikes, and five (25%) had injuries consistent with possible entanglement in fishing gear. One whale displayed scars that may have been caused by both ship strike and entanglement. Thus, 60% of the whale carcasses which were suitable for examination showed signs that anthropogenic factors may have contributed to, or been responsible for, their death.

Humpback whale entanglements 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).

Total average annual estimated fishery-related mortality and serious injury in fisheries monitored by NMFS between 1989-1993 was 1.0 humpback whale (CV = 3.10). If Canadian entanglements and the possible mid-Atlantic entanglement records reported above are considered, along with injuries that may lead to reduced viability and/or eventual mortality of formerly entangled whales, this number will likely increase. The total fishery-related mortality and serious injury for this stock is greater than 10% of the calculated PBR and cannot be considered insignificant and approaching zero mortality and serious injury rate. This determination cannot be made for specific fisheries until the implementing regulations for Section 118 of the MMPA have been reviewed by the public and finalized.

Fishery Information

The estimated total number of hauls in the Atlantic large pelagic drift gillnet fishery increased from 714 in 1989 to 1144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, and 1993 were 233, 243, and 232 respectively. Fifty-nine vessels participated in this fishery between 1989 and 1993. Observer coverage, percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992 and 42% in 1993. The greatest concentrations of effort were located along the southern edge of Georges Bank and off Cape Hatteras. Examination of the species composition of the catch and locations of the fishery throughout the year, suggested that the drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, for each year, were obtained using the aggregated catch rates, by strata (Northridge, in review). A single mortality was observed in January 1993 off Cape Hatteras. Estimated annual mortality (CV in parentheses), extrapolated from fishery observer data, was 0.7 (7.0) in 1989, 1.7 (2.65) in 1990, 0.7 (2.00) in 1991, 0.4 (1.25) in 1992, and 1.5 in 1993 (0.45).

Other Mortality

Between November 1987 and January 1988, 14 humpback whales died after consuming Atlantic mackerel containing a dinoflagellate saxitoxin. The whales subsequently stranded in the vicinity of Cape Cod Bay and Nantucket sound. During the first 6 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.

STATUS OF STOCK

The size of this stock is considered to be low relative to OSP and this species is listed as endangered under the ESA. There are insufficient data to determine the population trends for humpback whales. The annual rate of population increase was estimated at 9% (Katona and Beard 1990), but the lower 95% confidence level was less than zero. The total level of human-caused mortality and serious injury is unknown, but current data indicate that it is significant. This is a strategic stock because the humpback whale is listed as an endangered species under the ESA.

REFERENCES

Allen, J., P. Clapham, P. Hammond, S. Katona, F. Larsen, J. Lien, D. Mattila, N. Øien, P. Palsbøl, J. Sigurjonsson, and T. Smith. 1993. Years of the North Atlantic Humpback (YONAH): Progress Report. Rep. Int. Whal. Commn. SC/45/NA6.

Anon. 1994. Report of the PBR (Potential Biological Removal) workshop. June 27-29, 1994. NOAA, NMFS Southwest Fisheries Science Center, La Jolla, California, 13 pp. + Appendices.

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 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.

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.

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.

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.

Northridge, S. In review. Estimation of cetacean mortality in the U.S. Atlantic swordfish and tuna driftnet and pair trawl fisheries. Draft final report to the Northeast Fisheries Science Center, Contract No. 40ENNF500045, 18 pp.

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. Josssi. 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.

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

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.