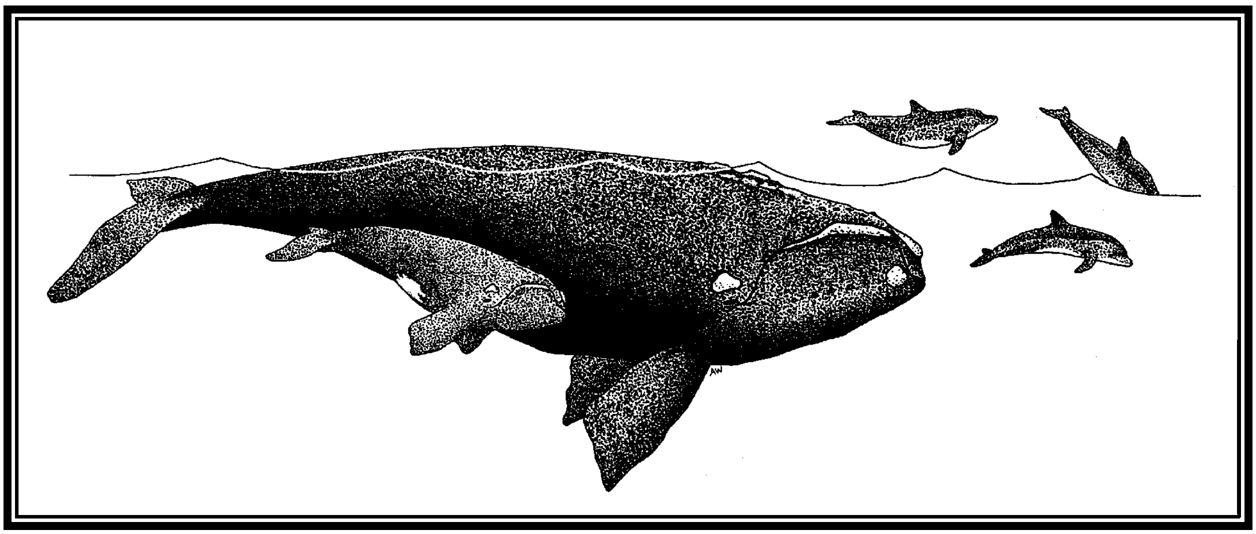
NOAA TECHNICAL MEMORANDUM
NMFS-SEFSC-363

U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments



By
Robert A. Blaylock, James W. Hain, Larry J. Hansen, Debra L. Palka, and Gordon T. Waring

with contributions from
Kathryn Bisack, Mark Bravington, Simon Northridge, Janeen Quintal, Belinda Rubenstein, and Amy Williams

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
Miami, Florida 33149-1003

July 1995

NOAA TECHNICAL MEMORANDUM
NMFS-SEFSC-363

U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments

By

Robert A. Blaylock, James W. Hain, Larry J. Hansen,
Debra L. Palka, and Gordon T. Waring

with contributions from
Kathryn Bisack, Mark Bravington, Simon Northridge,
Janeen Quintal, Belinda Rubenstein, and Amy Williams

U.S. DEPARTMENT OF COMMERCE
Ronald H. Brown, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
D. James Baker, Administrator

NATIONAL MARINE FISHERIES SERVICE
Rolland A. Schmitten, Assistant Administrator for Fisheries

July 1995

NOTICE

This report should be cited as follows:

Blaylock, R. A., J. W. Hain, L. J. Hansen, D. L. Palka, and G. T. Waring. 1995. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments. NOAA Tech. Mem. NMFS-SEFSC-363, 211 pp.

Authors' affiliations: (RAB) National Marine Fisheries Service, Southeast Fisheries Science Center, Miami Laboratory, 75 Virginia Beach Drive, Miami, FL 33149-1003; (LJH) National Marine Fisheries Service, Southeast Fisheries Science Center, Charleston Laboratory, 217 Fort Johnson Road, Charleston, SC 29412; and (DLP, JWH, and GTW) National Marine Fisheries Service, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543.

Copies may be obtained by writing the authors or:

National Technical Information Service
5258 Port Royal Road
Springfield, VA 22161
Telephone: (703) 487-4650
FAX: (703) 321-8547
Rush Orders: (800) 336-4300

TABLE OF CONTENTS

PREFACE

The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) were required to produce stock assessment reports for all marine mammal stocks in waters within the U.S. Exclusive Economic Zone under the 1994 amendments to the Marine Mammal Protection Act. This document contains the stock assessment reports for the U.S. Atlantic and Gulf of Mexico marine mammal stocks under NMFS jurisdiction. Marine mammal species which are under the management jurisdiction of the USFWS are not included in this report.

The Sea Sampling Investigations Unit at the Northeast Fisheries Science Center and the Oceanic Pelagic Resources Division at the Southeast Fisheries Science Center Miami Laboratory provided marine mammal by-catch and fisheries effort data. The Southeast U.S. Marine Mammal Stranding Network provided data on stranded marine mammals in the NMFS Southeast Region and information on stranded marine mammals in the NMFS Northeast Region was provided by the NMFS Northeast Regional Office. Amy Woodhead produced the cover illustration and Mary Nuñez proof-read the final draft.

The authors wish to acknowledge the valuable contribution of the Atlantic Scientific Review Group which provided the authors with constructive criticism of the draft assessment reports. Members of the Atlantic Scientific Review Group who reviewed draft assessment reports are: Solange Brault, Joseph DeAlteris, James R. Gilbert, Michael J. Harris, Robert D. Kenney, James G. Mead, Daniel K. Odell, Andrew J. Read, and Randall S. Wells. Their comments greatly improved the quality of the reports. The authors also appreciate the thoughtful reviews and comments of the Marine Mammal Commission, the Humane Society of the United States, and the NMFS Southeast and Northeast Regional Offices. The exhaustive review and comments of Paul Wade of NMFS Office of Protected Resources greatly improved the technical quality of the reports. Any omissions or errors are the sole responsibility of the authors.

This is a working document and individual stock assessment reports will be updated as new information becomes available and as changes to marine mammal stocks and fisheries occur; therefore, each stock assessment report is intended to be a stand alone document. The authors solicit any new information or comments which would improve future stock assessment reports.

This is Southeast Fisheries Science Center Contribution MIA-94/95-35.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Individuals of this population range from wintering and calving grounds in coastal waters of the southeastern United States to summer feeding, nursery, and mating grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf. Knowlton et al. (1992) recently reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland, suggesting an extended range for at least some individuals and perhaps habitat areas not presently well described. Likewise, a calving and wintering ground has been described for coastal waters of the southeastern U.S., but the range may be somewhat more extensive because sightings have been reported from the Gulf of Mexico (Moore and Clark 1963; Schmidly et al. 1972) and 85% of the population is unaccounted for during this season.

Research results to date suggest five major habitats or congregation areas (southeastern United States coastal waters, Great South Channel, Cape Cod Bay, Bay of Fundy, and Scotian Shelf) for western North Atlantic right whales. However, movements within and between habitats and within regions may be more extensive than sometimes thought. Results from a few successfully attached satellite telemetry tags suggest that sightings separated by perhaps two weeks should not be assumed to indicate a stationary or resident animal. Instead, telemetry data have shown rather lengthy and somewhat distant excursions (Mate et al. 1992). These findings cast new light on movements and habitat use, and raise questions about the purpose or strategies for such excursions.

New England waters are a primary feeding habitat for the right whale, which appears to feed primarily on calanoid copepods in this area. Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently. These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitat (Kenney et al. 1986). The acceptable surface copepod resource is limited to perhaps 3% of the region during the peak feeding season in Cape Cod and Massachusetts Bays (Mayo and Goldman, in press). While feeding in the coastal waters off Massachusetts has been better studied, feeding by right whales has been observed elsewhere over 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 is not well known. New England waters also serve as a nursery for calves and, in some cases, for mating.

Genetic analyses of tissue samples is providing insights to stock definition. Schaeff et al. (1993) have suggested that western North Atlantic right whales probably represent a single breeding population that may be based on three matrilines. They also suggest that, in addition to the Bay of Fundy, there exists an additional and undescribed summer nursery area utilized by approximately one-third of the population. As described above, a related question is where individuals other than calving females and a few juveniles overwinter. One or more major wintering and summering grounds have yet to be described.

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). Because this was a nearly complete census, it is assumed that this represents a minimum population size estimate.

Historical Population Estimate

An estimate of pre-exploitation population size is not available. Basque whalers may have taken as many as 200 right whales a year at times during the 1500s in the Strait of Belle Isle region, 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 eastern U.S 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, these authors could only conclude 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 are preliminary, and refinements are required.

Minimum Population Estimate

The western North Atlantic population size was estimated to be 295 individuals in 1992 (Knowlton et al. 1994), 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 years was dead (Knowlton et al. 1994). It is assumed that the census of identified whales represents a minimum population size estimate.

Current Population Trend

The size of this population may have been as low as 50 or fewer animals at the turn of the century (Reeves et al. 1992; Kenney 1992) versus an estimated 295 presently, suggesting that the stock is showing signs of slow recovery.

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 five to 17, with a mean of 11.2 (SE = 0.90). There was no detectable trend in the number of calves produced per year. 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 be increasing over time, although the trend was not quite statistically significant ($P = 0.083$) (Knowlton et al. 1994).

The current 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). The current estimated population growth rate of the western North Atlantic stock is lower than that of the four stocks of southern-hemisphere right whales for which data are available: western Australia, 12.7%; Argentina, 7.3%; east and west Africa, 6.8% (Best 1993).

The relatively low population size suggests that this stock is well below its optimum sustainable population (OSP); therefore, the current population growth rate should reflect the maximum net reproductivity rate for this stock. The current population growth rate reported by Knowlton et al. (1994) of 2.5% (CV = 0.12) was assumed to reflect the maximum net reproductivity rate for this stock for purposes of this assessment.

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 OSP (Anon. 1994). The recovery factor was 0.10 because this species is listed as endangered under the Endangered Species Act (ESA). PBR for the northern right whale is 0.4 whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Approximately one-third of all right whale mortality is caused by human activities (Kraus 1990). 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, perhaps recovery of the population, are ship strikes and net entanglement. Marks or scars from entanglement with fishing gear were reported from 57% of living right whales, and 7% had major wounds probably due to collisions with ship propellers. Of the 25 mortalities recorded, five (20%) could be attributed to ship collisions, and three (12%) were the result of entanglements. Young animals, ages 0-4 years, are apparently the most impacted portion of the population. In this age group, 20-30% of mortality is due to ship strikes (Kraus 1990).

For one area of concern, the coastal waters of the southeastern U.S., an awareness and mitigation program, involving ten agencies and organizations, was begun in 1992, and has been upgraded and expanded annually. Other areas may be included in the future. For waters of the northeastern U.S., 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 now under construction. Timetables for levels of treatment are under discussion.

Total estimated average annual fishery-related mortality and serious injury in fisheries monitored by NMFS during 1989-1993 was 1.6 right whales annually (CV = 2.80). The average reported mortality and serious injury to right whales due to ship strikes was one right whale per year during 1990-1994; therefore, estimated annual average human-induced mortality and serious injury (including fishery and non-fishery related causes) was 2.6 right whales per year. 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 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). In July of 1993, a one and a half year old female was released from a swordfish drift gillnet along the southern edge of Georges Bank. The wounding to the animal, including the tail stock, suggested a high likelihood of reduced viability. Under the assumption that this animal eventually died, the total estimated annual fishery-related mortalities (CV in parentheses) were 2.2 in 1989 (2.43), 3.4 in 1990 (2.37), 0.5 (1.49) in 1991, 0.4 in 1992 (1.44), and 1.3 in 1993 (0.63).

In this stock, 57% of living right whales bore evidence of entanglements with fishing gear. An entanglement database maintained by NMFS Northeast Regional Office with records from 1975-1992 included 14 right whale entanglements, including right whales in weirs, entangled in gillnets, and trailing line and buoys. Three right whales entangled or trailing line were reported from waters in the Gulf of Maine and Bay of Fundy region in summer/fall 1994 (P. K. Hamilton, personal communication). In February 1994, two and perhaps three right whales in southeastern U.S. coastal waters were reported injured in association with large-mesh gillnets (P. K Hamilton, personal communication). An additional record (M. J. Harris, personal communication) reported a 9.1-10.6 m right whale entangled and released south of Ft. Pierce, Florida in March 1982. Incidents of entanglements in groundfish gillnet gear, cod traps, and herring weirs in waters of Atlantic Canada were summarized by Read (1994). In most instances, the right whales were either released or escaped on their own, although several whales have been observed carrying net or line fragments. 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). There have been five known ship strikes, causing three injuries and two mortalities in coastal waters of the southeastern U.S. since the Kraus (1990) summary report was published. There were also two mortalities likely due to ship collisions in the Bay of Fundy area, 1992 and 1994, and two reported floaters off the mid-Atlantic, winter 93-94, possibly due to ship strikes (NMFS unpublished data; P. K Hamilton, personal communication; Kenney and Kraus 1993). There have been four ship strike mortalities, a fifth probable, and two more possible during 1990-1994, yielding a human-induced, non-fishery-related mortality rate of between 0.8 and 1.4 right whales a year. As with entanglements, some injury or mortality due to ship strikes, particularly in offshore waters, may go undetected.

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. A Recovery Plan has been published and is in effect (NMFS 1991). The total level of human-caused mortality and serious injury is unknown, but reported human-caused mortality and serious injury has exceeded two right whales per year since 1990. This rate exceeds PBR and is significant because of the critically low population size and the low population growth rate. This is a strategic stock because the North Atlantic right whale is an endangered species.

REFERENCES

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.

Best, P. B. 1993. Increase rates in severely depleted stocks of baleen whales. ICES J. Mar. Sci. 50: 169-186.

Hain, J. (editor). 1992. The right whale in the western North Atlantic: A science and management workshop, 14-15 April 1992, Silver Spring, Maryland. Northeast Fisheries Science Center Reference Document No. 92-05, NEFSC/NMFS Woods Hole, Massachusetts, 88 pp.

Kenney, R. D., M. A. M. Hyman, R. E. Owen, G. P. Scott, and H. E. Winn. 1986. Estimation of prey densities required by western North Atlantic right whales. Mar. Mam. Sci. 2(1): 1-13.

Kenney, R. D. 1992. Western North Atlantic right whales: Abundance and trends from Great South Channel aerial surveys. Pages 47-49 *in* J. Hain (editor), The right whale in the western North Atlantic: A science and management workshop, 14-15 April 1992, Silver Spring, Maryland. Northeast Fisheries Science Center Reference Document No. 92-05, NMFS, NEFSC, Woods Hole, Massachusetts, 88 pp.

Kenney, R. D., H. E. Winn, and M. C. Macula. 1995. Cetaceans in the Great South channel, 1979-1989: right whale (*Eubalaena glacialis*). Cont. Shelf Res. 15: 385-414.

Kenney, R. D. and S. D. Kraus. 1993. Right whale mortality — a correction and an update. Mar. Mamm. Sci. 9: 445-446.

Knowlton, A. R., J. Sigurjonsson, J. N. Ciano, and S. D. Kraus. 1992. Long-distance movements of North Atlantic Right whales (*Eubalaena glacialis*). Mar. Mam. Sci. 8(4): 397-405.

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.

Kraus, S. D. 1990. Rates and potential causes of mortality in North Atlantic right whales (*Eubalaena glacialis*). Mar. Mamm. Sci. 6(4): 278-291.

Kraus, S. D. and R. D. Kenney. 1991. Information on right whales (*Eubalaena glacialis*) in three proposed critical habitats in United States waters in the western North Atlantic Ocean. Pub. No. PB91-194432, NTIS, Springfield, Virginia, 65 pp.

Mate, B. R., S. Nieukirk, R. Mescar, and T. Martin. 1992. Application of remote sensing methods for tracking large cetaceans: North Atlantic right whales (*Eubalaena glacialis*). Final Report to the Minerals Management Service, Contract No. 14-12-0001-30411, 167 pp.

Mayo, C. A. and L. A. Goldman. In press. Food consumption and caloric intake of the right whale, *Eubalaena glacialis*, in Cape Cod Bay. Can. J. Zool.

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. and E. Mitchell. 1987. Shore whaling for right whales in the northeastern United States. Contract Report No. NA85-WCC-06194, SEFSC/NMFS, Miami, FL, 108 pp.

Reeves, R. R., J. M. Breiwick, and E. Mitchell. 1992. Pre-exploitation abundance of right whales off the eastern United States. Pages 7-11 *in* The right whale in the western North Atlantic: A science and management workshop, 14-15 April 1992, Silver Spring, Maryland. Northeast Fisheries Science Center Reference Document No. 92-05. NEFSC/NMFS, Woods Hole, Massachusetts, 88 pp.

Schaeff, C. M., S. D. Kraus, M. W. Brown, and B. N. White. 1993. Assessment of the population structure of the western North Atlantic right whales (*Eubalaena glacialis*) based on sighting and mtDNA data. Can. J. Zool. 71: 339-345.

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

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.

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 U.S., north to Nova Scotia and on to the southeast 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. Whether the current stock boundaries define biologically isolated units is uncertain, and confirmation or revision awaits input from techniques such as molecular genetics or telemetry. The existence of a subpopulation structure was suggested by local depletions that resulted from commercial over harvesting (Mizroch et al. 1984).

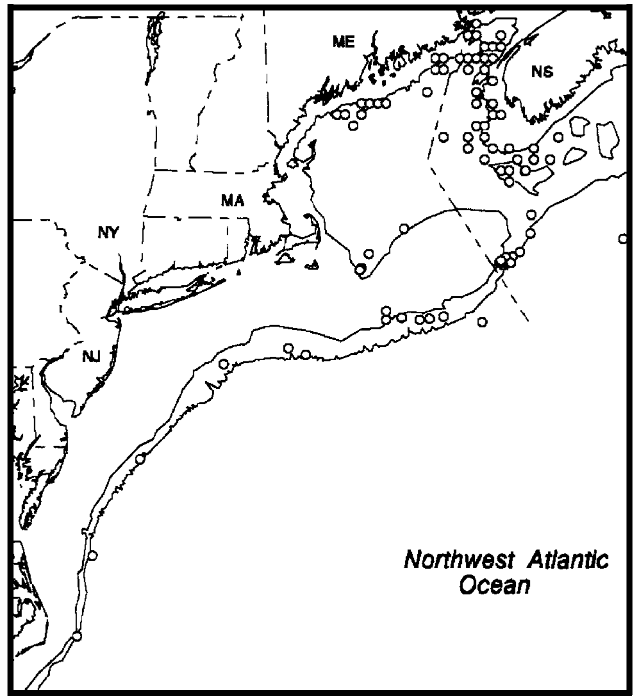


Figure 1. *Distribution of fin whale sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

Fin whales are common in waters of the U.S. Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward (Fig. 1). Fin whales accounted for 46% of the large whales and 24% of all cetaceans sighted over the continental shelf during aerial surveys (CeTAP) 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 the dominant 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 (Hain et al. 1992).

There is little doubt that New England waters constitute a major feeding grounds for the fin whale. There is evidence of site fidelity by females, and perhaps some substock separation 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 years, and 45% were sighted between 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. 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.

Hain et al. (1992), based on an analysis of neonate stranding data, suggested that calving takes place during approximately four months from October-January in latitudes of the U.S. mid-Atlantic region; however, it is unknown where calving, mating, and wintering for most of the population occurs. Preliminary results from the Navy's IUSS program (C. Clark, unpublished data) suggest a deep-ocean component to fin whale distribution. It is likely that fin whales occurring in the U.S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps more equatorial regions.

POPULATION SIZE

A population estimate based on an inverse variance weighted pooling of CeTAP (1982) spring and summer data is 4,680 fin whales [coefficient of variation (CV) = 0.23] and includes a dive-time correction factor of 4.85. An average for these two seasons was chosen because the greatest proportion of the population off the northeast U.S. coast appears to be in the CeTAP study area in these seasons. However, this estimate is highly uncertain because the data are a decade old, and values were estimated just after cessation of extensive foreign fishing operations in the region.

More recent abundance estimates, based on aerial surveys in August-October 1991, a shipboard survey during June-July 1991, and shipboard surveys conducted during the summer in 1991 and 1992, are available. In each case, the estimates are for a portion of the northeastern U.S. Atlantic EEZ during one or two seasons.

An aerial survey in the CeTAP study area, which included an interplatform experiment between a Twin Otter and an AT-11, was conducted from August-October 1991. The survey repeated many of the CeTAP-defined survey blocks and added several continental slope survey blocks; however, due to weather and logistical constraints, several survey blocks south and east of Georges Bank were not surveyed. The data were analyzed using DISTANCE (Buckland et al. 1993; Laake et al. 1993) and confidence intervals were calculated using the bootstrap log-normal method. The resulting abundance estimates were 529 fin whales (CV = 0.19) and 194 fin whales (CV = 0.18), respectively, for the AT-11 and Twin Otter. Data were not pooled because the interplatform calibration analysis has not been conducted. These estimates are not comparable to the CeTAP estimates, because the 1991 data are from a single survey, August-October and the CeTAP estimates were based on data pooled over several years of seasonal surveys.

The abundance estimate from the June-July 1991 shipboard survey along the southern and northeast margin of Georges Bank, approximately between the 200 and 2,000 m isobaths, was 35 fin whales (CV = 0.56).

For the summer 1991-92 shipboard surveys, a weighted-average abundance for the northern Gulf of Maine-lower Bay of Fundy region is 2,700 fin whales (CV = 0.59), where each annual estimate is weighted by the inverse of its variance (NMFS unpublished data). The data used were obtained from two shipboard line transect sighting surveys designed to estimate abundance of harbor porpoises (Palka, in press). Two independent teams of observers on the same ship surveyed using the naked eye in non-closing mode. The abundance estimate includes an estimate of g(0), probability of detection, for both teams combined, of 0.52 (CV = 0.19). [Using each team's data separately produces a g(0) value of 0.32 (CV = 0.26)]. The g(0)-corrected abundance estimate was calculated using the product interval analytical method (Palka, in press). Variability was estimated using bootstrap resampling techniques. Several qualifications are appropriate. First, the study area was stratified by water depth and expected density of harbor porpoises. This stratification scheme could cause uncertainties in a fin whale abundance estimate because offshore waters in the central northern Gulf of Maine, which may be part of the fin whale habitat but not part of the harbor porpoise habitat, were surveyed at a low intensity. To produce the fin whale abundance estimate, it was assumed that observed densities of fin whales in the surveyed offshore waters were similar to densities in the unsurveyed offshore waters. This is not unreasonable. Second, this estimate has not explicitly accounted for dive times and ship avoidance; both factors are expected to influence the abundance estimate for this species.

Minimum Population Estimate

The minimum population estimate is based on the 1991-92 shipboard survey abundance estimate of 2,700 whales (CV = 0.59) (NMFS unpublished data). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994), and was 1,704 fin whales.

Current Population Trend

There are insufficient data to determine the 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. 1992).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value is based on theoretical calculations showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Anon. 1994). 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.

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 the fin whale is listed as endangered under the Endangered Species Act (ESA). PBR for this stock is 3.4 whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The number of fin whales taken at three whaling stations in Canada from 1965-71 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 1989-1993. The total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and can 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

No fishery-related mortality or serious injury of fin whales was reported in the Sea Sampling by-catch database; therefore, no detailed fishery information is presented here.

Fin whales were reported as entangled on nine occasions in an entanglement database maintained by NMFS NE Regional Office including records from 1975-1992. Two of the nine were dead and the fate of others is unknown. Five of the entanglement records were of whales entangled in or trailing line of an unspecified source and three records were of entanglement with lobster-pot gear and line.

Because of the large role of fin whales in their ecosystem (Hain et al. 1992), there is likely a link between the abundance of fin whales and the fishery resources. Foreign fishing activities in the 1960s and 70s may have been more important ecologically to the fin whale, as compared to direct interactions, since these activities over-exploited several fish stocks (i.e., herring, mackerel, etc.) that are known fin whale prey. On the other hand, Sissenwine et al. (1984) speculated that fin whales contributed to the demise of the already overfished Georges Bank herring stock in the mid- and late 1970s.

Ship Strikes

There are nine records of ship collisions, boat strikes, and propeller scars between 1980-1994 in the Smithsonian Institution's Marine Mammal database. This is a small number of individuals relative to the size of the population.

STATUS OF STOCK

The status of this stock relative to OSP is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine the population trends for fin whales. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant. Any fishery-related mortality would be illegal because there is no recovery plan currently in place. This is a strategic stock because the fin whale is listed as an endangered species under the ESA.

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.

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.

Best, P. B. 1993. Increase rates in severely depleted stocks of baleen whales. ICES Jour. Mar. Sci. 50: 169-186.

Buckland, S. T., D. R. Andersen, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman and Hall, New York, 446 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. J. Ratnaswamy, R. D. Kenney, and H. E. Winn. 1992. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. Rep. Int. Whal. Commn. 42: 653-669.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

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 (editor), The whale problem: A status report. Harvard University Press, Cambridge, Massachusetts, 419 pp.

Palka, D. In press. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. Int. Whal. Commn. Special Issue 16.

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

Sissenwine, M. P., W. J. Overholtz, and S. H. Clark. 1984. In search of density dependence. Pages 119-137 *in* Proceedings of the workshop on biological interactions among marine mammals and commercial fisheries in the southeastern Bering Sea. Alaska Sea Grant Report 84-1, Alaska Sea Grant College Program, University of Alaska, Fairbanks, Alaska.

SEI WHALE (*Balaenoptera borealis*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Indications are that, at least during the feeding season, the 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 U.S. 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). The sei whale is generally found in the deeper waters characteristic of the continental shelf edge region (Hain et al. 1985). Mitchell (1975) similarly 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. The sei whale, like the right whale, is 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 and Stellwagen Bank areas (Kenney, personal communication; Payne et al. 1990). An influx of sei whales into the southern Gulf of Maine occurred in the summer of 1986 (Schilling et al. 1992).

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 Nova Scotian stock includes the continental shelf waters of the northeastern U.S., 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.

POPULATION SIZE

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. Based on census data, they estimated a minimum Nova Scotian population of 870 sei whales.

The total number of sei whales in the U.S. Atlantic EEZ is unknown. Seasonal abundance estimates are available from an aerial survey program conducted in the continental shelf and shelf edge waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982). A spring population estimate of 253 (CV = 0.63) was based on CeTAP (1982) data. This estimate is not corrected for submerged animals that may have gone unsighted by the aerial surveys. Spring data were used since it was the only seasonal estimate provided in CeTAP (1982). This estimate may not reflect the current true population because of the fact that data are a decade old and because of low survey effort in areas and seasons that are likely to be significant for sei whales. No sei whales were sighted during an August-October 1991 aerial survey in the CeTAP study area (NMFS unpublished data); therefore, there are no current estimates of sei whale abundance.

Minimum Population Estimate

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value is based on theoretical calculations showing that cetacean populations may not 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). No PBR can be calculated because 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 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 a sei whale carcass hung on the bow of a container ship as it docked in Boston on November 17, 1994. The crew estimated that the whale had been hung on the bow for approximately four days prior to the ship's arriving in port. There was no reported fishery-related mortality or serious injury to fin whales in fisheries observed by NMFS during 1989-1993. The total fishery-related mortality and serious injury for this stock is unknown, but can 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

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 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 it is believed to be insignificant. Any fishery-related mortality would be unlawful because there is no recovery plan currently in place. This is a strategic stock because the sei whale is listed as an endangered species under the ESA.

REFERENCES

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.

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. 1992. 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.

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 is very little 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 population, which inhabits the area from the eastern half of the Davis Strait out to 45°W and south to the Gulf of Mexico. The relationship between this and the other three populations is uncertain.

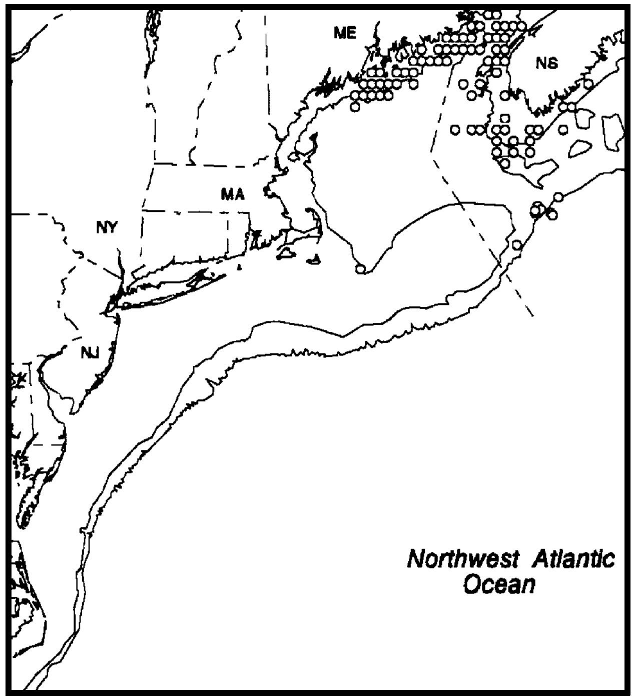


Figure 1. *Distribution of minke whale sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

The minke whale is the third most abundant large whale in the U.S. Atlantic Exclusive Economic Zone (EEZ). It is common and widely distributed (CeTAP 1982); however, because of its smaller size, more rapid movements, and less observable behavior, there is more uncertainty about abundance, distribution, and behavior than for other large cetaceans. There appears to be a strong seasonal component to minke whale distribution. Spring and summer are times of relatively widespread and common occurrence, and they are most abundant in New England waters during this time. The number of minke whales and the area occupied by them is reduced in the fall. In winter, the species appears to be largely absent from the area. 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.

POPULATION SIZE

The total number of minke whales in the Canadian East Coast population is unknown. However, three estimates exist for portions of the habitat — a 1978-1982 estimate (CeTAP 1982), a shipboard survey estimate from the summers of 1991 and 1992, and a shipboard estimate, from June-July 1993.

Seasonal abundance estimates are available from an aerial survey program conducted in the continental shelf and continental shelf edge waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982). A spring population estimate of 320 minke whales was based on CeTAP (1982) data [coefficient of variation (CV) = 0.23]. This estimate may not reflect the actual population size because a dive-time correction was not included, the data are a decade old, and survey effort was low in certain seasons and areas (e.g., the fall season on eastern and southeastern Georges Bank).

Minke whale abundance in the northern Gulf of Maine-lower Bay of Fundy region during the summers of 1991 and 1992 was estimated to be 2,650 minke whales (CV = 0.31). This is a weighted-average abundance estimate where each annual estimate is weighted by the inverse of its variance (NMFS unpublished data). The data used in estimating minke whale abundance were obtained from two shipboard line transect sighting surveys designed to estimate abundance of harbor porpoises (Palka, in press). Two independent teams of observers on the same ship surveyed using the naked eye in non-closing mode. The abundance estimate includes an estimate of g(0), probability of detection, for both teams of 0.60 (CV = 0.12) [using each team's data separately produced a g(0) value of 0.31 (CV = 0.22)]. The g(0)-corrected abundance estimate was calculated using the product interval analytical method (Palka, in press). Variability was estimated using bootstrap resampling techniques.

The 1991-1993 estimates suggest that minke whale abundance may be an order of magnitude greater than was estimated by CeTAP in 1982; however, two qualifications to the estimate must be made. The study area was stratified by water depth and expected density of harbor porpoises, although the observed distribution of minke whales suggests that the stratification scheme was appropriate for minke whales. Secondly, this estimate has not accounted for dive times and ship avoidance. Both of these behavioral factors could significantly influence the abundance estimate, but if they were taken into account this would probably not result in a lower abundance estimate.

An abundance estimate was also derived in a limited portion of the stock range using data collected during a June-July 1993 NEFSC shipboard line transect survey conducted between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the entrance to the Northeast Channel, and to the southwestern edge of the Scotian Shelf. The estimate for this area is 330 whales (CV = 0.66).

There are no estimates of abundance for this species in Canadian waters, which lie farther north or east of the above two surveys.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance average estimate of 2,650 whales based on the 1991-1992 surveys (CV = 0.31) (NMFS unpublished data), which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994), and was 2,053 minke whales. The 1991-1992 survey was used because it covered a larger proportion of the known habitat than that covered during the 1993 survey. The Gulf of Maine and Georges Bank abundance estimates were not combined because the June-July 1993 Georges Bank survey was conducted at a place through which minke whales migrate to spend the summer in the Gulf of Maine (the time and place of the 1991-1992 surveys).

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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).

Some biological parameters that could be used to estimate this rate are as follows. 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).

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 0.50 because of the stock's status relative to its OSP level is unknown. PBR for this stock is 21 whales.

ANNUAL HUMAN-CAUSED MORTALITY AND INJURY

In U.S. waters, an entanglement database maintained by NE Regional Office for 1975-1992 includes 36 records of minke whales. The gear includes unspecified fishing net, unspecified cable or line, fish trap, weirs, seines, gillnets, and lobster gear. In a review of cetaceans and fishery interactions, Read (1994) reported that a minke whale was found dead in a Rhode Island fish trap in 1976, and that a minke whale was trapped and released alive in a herring weir off northern Maine in 1990. One minke whale was reported caught in a bluefin tuna purse seine off Stellwagen Bank in 1991 and released uninjured (D. Beach, NMFS NE Regional Office, personal communication).

The only two records of minke whales in the NEFSC Sea Sampling database were from July 1991, south of Penobscot Bay, Maine, and October 1992, off the coast of New Hampshire near Jeffreys Ledge, in the Gulf of Maine sink gillnet fishery. One was dead, one was released alive. A minke whale was caught and released 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). An immature female minke whale, entangled with line around the tail stock, came ashore on the Jacksonville, Florida, jetty on 31 January 1990, and 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, personal communication).

Information about minke whale interactions with fishing gear is not well quantified or recorded in most parts of Canada. The following were reported in Read (1994). Six minke whales were reported entangled in gillnets in Newfoundland and Labrador during 1989. One of these animals escaped towing gear, the rest died. Five minke whales were entrapped and died in Newfoundland cod traps during 1989. During 1980 and 1990, 15 of 17 minke whales were released alive from herring weirs in the Bay of Fundy. In 1990, ten minke whales were trapped in the Bay of Fundy weirs, but all were released alive. Salmon gillnets in Canada have taken a few minke whales. In Newfoundland in 1979, one minke whale died in a salmon net. Between 1979 and 1990, it was estimated that 15% of the minke whale takes were in salmon gillnets.

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 all other North Atlantic populations are presently still being harvested at low levels, at less than 300 animals per population.

Because minke whales inhabit coastal waters during much of the year, they may be affected by pollution. For example, the levels of polychlorinated biphenyls in blubber from minke whales in the St. Lawrence estuary in Canada were high (Gaskin 1985).

Indirect impacts on prey species are also possible. Fish in the diet of minke whales include herring, capelin, cod, pollock, salmon, mackerel and sand lance. All of these species, except sand lance, are commercially harvested; and cod and pollock are considered as fully exploited or overexploited (NMFS 1993). Consequentially, the abundance and distribution of minke whales may be affected by the commercial fishing of the above fish and squid species.

Accurate estimates of human-caused mortality are not available because it is likely that many entanglements, injuries, and mortalities go unobserved and/or unrecorded, and existing data are fragmentary. Total annual estimated average fishery-related mortality and serious injury to this stock in the Atlantic in fisheries observed by NMFS during 1990-1993 was 2.5 minke whales (CV = 1.92). The total fishery-related mortality and serious injury for this stock is greater than 10% of the calculated PBR and, therefore, cannot be considered to be 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

Prior to 1977, there was no documentation of marine mammal by-catch in distant-water fleet (DWF) activities off the northeast coast of the U.S. With implementation of the Magnuson Fisheries Conservation and Management Act in that year an observer program was established which has recorded fishery data and information of incidental by-catch of marine mammals. In 1982, there were 112 different foreign vessels; 16%, or 18, were Japanese tuna longline vessels operating along the U.S. 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 number of Japanese longline vessels operating within the EEZ each year were 3, 5, 7, 6, 8, and 8, respectively. Observer coverage was 100%. No mortalities were observed, but one animal was released alive in September 1986 (Waring et al. 1990).

There are approximately 349 vessels (full and part time) in the New England multispecies sink gillnet fishery (Walden, in review). Observer coverage in trips has been 1%, 6%, 7.5%, and 5% for years 1990 to 1993. The fishery has been observed in the Gulf of Maine and in Southern New England. One mortality was observed in this fishery in 1991. Estimated fishery-related mortality and serious injury attributable to this fishery was ten minke whales (CV =

0.96) in 1991 (Northridge, in review). Annual estimated average fishery-related mortality and serious injury to this stock in the Atlantic during 1990-1993 attributable to the sink gillnet fishery was 2.5 minke whales (CV = 1.92).

The Canadian groundfish gillnet fishery is important and widespread. Many fisherman hold groundfish gillnet licenses but the number of active fisherman are unknown. In 1989, approximately 6,800 licenses were issued to fishermen along the southern coast of Labrador, and northeast and southern coast of Newfoundland. In the Gulf of St. Lawrence, there were about 3,900 licenses issued in 1989, while in the Bay of Fundy and southwestern Nova Scotia 659 licenses were issued.

There were 3,121 cod traps operating in Newfoundland and Labrador during 1979. That number was estimated to have grown to about 7,500 in 1980. The cod trap fishery in Newfoundland closed in 1993 due to the depleted groundfish resources.

The Atlantic Canadian and Greenland salmon gillnet fishery is seasonal, with the peak from June to September, depending on the location. In southern and eastern Newfoundland, and Labrador during 1989, there were 2,196 gear units used, where each gear unit consist of a net 91 m long. There is no effort data available for the Greenland fishery. However the fishery was stopped in 1993 as a result of an agreement between the fishermen and North Atlantic Salmon Fund (Read 1994). There was no reported fishery-related mortality or serious injury to minke whales in this fishery.

In U.S. and Canadian waters the herring weir fishery occurs from May to September each year along the southwestern shore of the Bay of Fundy, and scattered along the western Nova Scotia and northern Maine coasts. In 1990 there were 180 active weirs in western Bay of Fundy, and 56 active weirs in Maine (Read 1994). There was no reported fishery-related mortality or serious injury to minke whales in this fishery in U.S. Atlantic EEZ waters.

Ship Strikes

Minke whales inhabit coastal waters during much of the year and are subject to collision with vessels. In one record in the NE Regional Office marine mammal stranding database, on 7 July 1974, the necropsy suggested a vessel collision.

STATUS OF STOCK

The status of minke whales relative to OSP in the U.S. Atlantic EEZ is unknown. The minke whale is not listed as endangered under the Endangered Species Act (ESA). In Canada, the Cetacean Protection Regulations of 1982, promulgated under the standing Fisheries Act, prohibit the catching or harassment of all species of cetaceans, including the minke whale. The level of human-caused mortality and serious injury is not likely to be high relative to stock size because while fishery interactions do occur, most minke whales escape or are released unharmed. 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. 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, 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.

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.

Gaskin, D. E. 1985. The ecology of whales and dolphins. Heinemann Educational Books, Inc. Portsmouth, NH.

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. 316 pp.

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.

NMFS [National Marine Fisheries Service]. 1993. Status of fishery resources off the northeastern United States for 1993. NOAA Tech. Mem. NMFS-F/NEC 101.

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.

Palka, D. In press. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. Int. Whal. Commn. Special Issue 16.

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.

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

Walden, J. In review. Results of the Gulf of Maine gillnet survey 1989-92. NOAA, NMFS, NEFSC [Northeast Fisheries Science Center] Ref. Doc., Woods Hole, Massachusetts.

BLUE WHALE (*Balaenoptera musculus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of the blue whale, *Balaenoptera musculus,* in the western North Atlantic generally extends from the Arctic to at least mid-latitudes. Blue whales are most frequently sighted in the waters off eastern Canada, with the majority of recent records from the Gulf of St. Lawrence (Sears et al. 1987). The species was hunted around Newfoundland in the first half of the 20th century (Sergeant 1966). The present Canadian distribution, broadly described, is spring, summer, and fall in the Gulf of St. Lawrence, especially along the north shore from the St. Lawrence River estuary to the Strait of Belle Isle and off eastern Nova Scotia. The species occurs in winter off southern Newfoundland and also in summer in Davis Strait (Mansfield 1985).

The blue whale is best considered as an occasional visitor in U.S. Atlantic Exclusive Economic Zone (EEZ) waters, which may be the current southern limit of its range (CeTAP 1982; Wenzel et al. 1988). All of the five sightings described in the foregoing two references were in August. Yochem and Leatherwood (1985) summarized records that suggested an occurrence of this species south to Florida and the Gulf of Mexico, although the actual southern limit of the species' range is unknown.

The blue whale may be nomadic and open-ocean in habitat. In one example, an individual was tracked from near Newfoundland to south of Bermuda (Gagnon and Clark 1993).

POPULATION SIZE

Little is known except for the Gulf of St. Lawrence area. Here, 308 individuals have been catalogued (Sears et al. 1987). Mitchell (1974) estimated that the blue whale population in the western North Atlantic may number only in the low hundreds. R. Sears (personal communication) suggests that no present evidence exists to refute this estimate.

Minimum Population Estimate

The 308 recognizable individuals from the Gulf of St. Lawrence area which were catalogued by Sears et al. (1987) is considered to be a minimum population estimate.

Current Population Trend

There are insufficient data to determine the population trends for this species. Off west and southwest Iceland, an increasing trend of 4.9% a year was reported for the period 1969-1988 (Sigurjonsson and Gunnlaugsson 1990).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 the species is listed as endangered under the Endangered Species Act (ESA). PBR for this stock is 0.6 blue whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no records of fishery-related mortality or serious injury to blue whales in the U.S. Atlantic EEZ. Total fishery-related mortality and serious injury for this stock is 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

No fishery information is presented because there are no observed fishery-related mortalities or serious injury.

STATUS OF STOCK

The status of this stock relative to OSP is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine population trends for blue whales. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant. Any fishery-related mortality would be unlawful because there is no recovery plan currently in place. This is a strategic stock because the blue whale is listed as an endangered species under the ESA.

REFERENCES

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.

Gagnon, G. J. and C. W. Clark. 1993. The use of U.S. Navy IUSS passive sonar to monitor the movement of blue whales. *Abstract*, Tenth Biennial Conference on the Biology of Marine Mammals, Galveston, TX, 11-15 November 1993.

Mansfield, A. W. 1985. Status of the blue whale, *Balaenoptera musculus*, in Canada. Canadian Field Naturalist 99(3): 417-420.

Mitchell, E. 1974. Present status of northwest Atlantic fin and other whale stocks. Pages 108-169 *in* W. E. Schevill (editor), The whale problem: A status report. Harvard University Press, Cambridge, Massachusetts, 419 pp.

Sears, R., F. Wenzel, and J. M. Williamson. 1987. The blue whale: a catalog of individuals from the western North Atlantic (Gulf of St. Lawrence). Mingan Island Cetacean Study, St. Lambert, Quebec, Canada, 27 pp.

Sergeant, D. E. 1966. Populations of large whale species in the western North Atlantic with special reference to the fin whale. Fish. Res. Board. Canada Circular No. 9, 30 pp.

Sigurjonsson, J. and T. Gunnlaugsson. 1990. Recent trends in abundance of blue (*Balaenoptera musculus*) and humpback whales (*Megaptera novaeangliae*) off west and southwest Iceland, with a note on occurrence of other cetacean species. Rep. Int. Whal. Commn. 40: 537-551.

Wenzel, F., D. K. Mattila, and P. J. Clapham. 1988. *Balaenoptera musculus* in the Gulf of Maine. Mar. Mam. Sci. 4(2): 172-175.

Yochem, P. K. and S. Leatherwood. 1985. Blue whale. Pages 193-240 *in* S. H. Ridgeway and R. Harrison (editors), Handbook of Marine Mammals, Vol. 3: The Sirenians and Baleen Whales, Academic Press, New York.

SPERM WHALE (*Physeter macrocephalus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The sperm whale is reported during all four seasons along the continental shelf edge in the northeastern U.S. Atlantic coast Exclusive Economic Zone (EEZ) (CeTAP 1982). These data as well as observations in the literature suggest that the distribution of the sperm whale continues well beyond the continental shelf edge, over the continental slope, and into mid-ocean regions (Fig. 1). Waring et al. (1993) suggest that this offshore distribution is more commonly associated with the Gulf Stream edge and other features. In the shoreward direction, Hain and Kenney (unpublished data) report an occurrence on the continental shelf from August through November inshore of the 100m depth contour south of New England and on the southern Scotian Shelf.

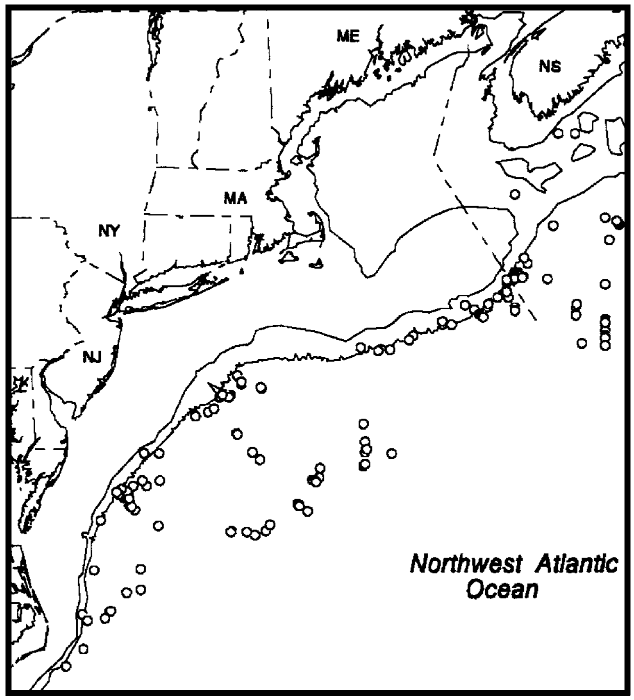


Figure 1. *Distribution of sperm whale sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

There appears to be a distinct seasonal cycle. In winter, sperm whales are concentrated east and northeast of Cape Hatteras. In spring, the center of distribution shifts northward to east of the Delmarva peninsula, and is widespread throughout the central portion of the mid-Atlantic bight and the southern portion of Georges Bank. In summer, the distribution is similar but now also includes the area east and north of Georges Bank and into the Northeast Channel region, as well as the continental shelf south of New England. In the fall, sperm whale occurrence south of New England on the continental shelf is at its highest level, and there remains a continental shelf edge occurrence in the mid-Atlantic bight.

The sperm whales that occur in the eastern U.S. EEZ likely represent only a fraction of the total stock, perhaps at a lateral periphery of the entire range. The nature of linkages of this habitat with those to the south, north, and offshore is unknown. Historical whaling records compiled by Schmidly (1981) suggest an offshore distribution off the southeast U.S., over the Blake Plateau, and offshore in the deep ocean. In the southeast Caribbean, both large and small adults, as well as calves and juveniles of different sizes are reported (Watkins et al. 1985).

Geographic distribution of sperm whales may be linked to their social structure and their low reproductive rate and both of these factors have management implications. Several basic groupings or social units are generally recognized — nursery schools, harem or mixed schools, juvenile or immature schools, bachelor schools, bull schools or pairs, and solitary bulls (Best 1979). These groupings have a distinct geographical distribution, with females and juveniles generally based in tropical and subtropical waters, and males more wide-ranging and occurring in higher latitudes. The basic social unit of the sperm whale appears to be the mixed school of adult females plus their calves and some juveniles of both sexes, normally numbering 20-40 animals in all. There is evidence that some social bonds persist for many years. Sperm whales have a very low reproductive rate, probably the lowest recorded for any marine mammal to date. The gestation period is estimated at 14-16 months, with a 5-year reproductive cycle.

POPULATION SIZE

The total numbers of sperm whales off the U.S. or Canadian Atlantic coast are unknown, though several estimates from selected regions of the habitat do exist. Seasonal abundance estimates are available from an aerial survey program conducted in continental shelf and continental shelf edge waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982). An estimate based on an inverse variance weighted pooling of CeTAP (1982) spring and summer data is 219 (CV = 0.36). An average for these two seasons was chosen because the greatest proportion of the population off the northeast U.S. coast appears to be in the CeTAP study area in these seasons. The data were analyzed using DISTANCE (Buckland et al. 1993; Laake et al. 1993), where the confidence interval was calculated using the bootstrap log normal method. This estimate was not corrected for g(0), the probability of detecting an animal group on the trackline.

Abundance estimates were also derived using data collected during an autumn 1991 line transect aerial survey in the CeTAP study area (NMFS unpublished data), which included an interplatform experiment between a Twin Otter and an AT-11), and from four fine-scale shipboard line transect surveys (August 1990, June-July 1991, June-July 1993, and August 1994) conducted in continental shelf edge and deeper oceanic waters (NMFS unpublished data). For both the aerial and shipboard surveys, sightings were almost exclusively in the continental shelf edge and continental slope areas. The 1991 aerial survey repeated many of the CeTAP-defined survey blocks, and added several continental slope survey blocks. Due to weather and logistical constraints, several survey blocks south and east of Georges Bank were not surveyed. Abundance estimates from this 1991 aerial survey were 337 (CV = 0.50) and 705 (CV = 0.66) for the AT-11 and NOAA Twin Otter, respectively. Data were not pooled, because the interplatform calibration analysis has not been conducted. Furthermore, these estimates are not fully comparable to the CeTAP estimates, because the 1991 data are from a single survey, August to October, while the CeTAP estimates were based on data pooled over several years of seasonal surveys.

An abundance estimate from the August 1990 shipboard survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank, is 338 (CV = 0.31). The 1991 shipboard survey estimate, based principally on sighting effort conducted between the 200 and 2,000 meter isobaths from Cape Hatteras to Georges Bank is 736 (CV = 0.36). The estimate for the 1993 survey, conducted principally between the 200 and 2,000 meter isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf is 116 (CV = 0.40). The 1994 estimate, based on survey effort within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank is 623 (CV = 0.52).

Because the estimates presented here were not dive-time corrected, they are likely downwardly biased and an underestimate of actual abundance. Given that the average dive-time of sperm whales is 45 min (W. A. Watkins, personal communication), the bias may be substantial.

Although the stratification schemes used in the 1990-1994 surveys did not always sample the same areas or encompass the entire sperm whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-94 data suggest that, seasonally, at least several hundred sperm whales are occupying these waters, with perhaps greater abundances in the mid Atlantic region. This is consistent with the earlier CeTAP data from a decade previous. Sperm whale abundance may increase offshore, particularly in association with Gulf Stream and warm-core ring features; however, at present there is no reliable estimate of total sperm whale abundance in the western North Atlantic.

Minimum Population Estimate

The minimum population estimate was based on the AT-11 aerial survey population estimate in autumn 1991 of 337 sperm whales (CV = 0.50). This estimate was selected because the AT-11 survey provided the most complete coverage of continental shelf edge and continental slope waters off the northeast U.S. coast. The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994), and was 226 sperm whales.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

While more is probably known about sperm whale life history in other areas, some life history and vital rates information is available for the northwest Atlantic. Some of the life history parameters which have been estimated include: calving interval is 3-4 years, lactation period is 24 months, gestation period is 14.5-16.5 months, births occur mainly in July to November, length at birth is 405 cm, length at sexual maturity 11.0-12.0 m for males, and 8.3-9.2 m for females, mean age at sexual maturity is 19 years for males and 9 years for females, and mean age at physical maturity is 45 years for males and 30 years for females (Best 1974; Lockyer 1981).

Current and maximum net productivity rates for this stock are not known. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 is 0.10 because this species is listed as endangered under the Endangered Species Act (ESA). PBR for this stock is 0.5 sperm whales.

ANNUAL HUMAN-CAUSED MORTALITY

Four hundred twenty-four sperm whales were taken in the Newfoundland-Labrador area between 1904-1972 and 109 sperm whales were taken near Nova Scotia in 1964-1972 (Mitchell and Kozicki 1984) in a Canadian fishery. There was also a well-documented sperm whale fishery based on the west coast of Iceland. Other sperm whale catches occurred near West Greenland, the Azores, Madeira, Spain, Spanish Morocco, Norway (coastal and pelagic), Faroes, and British coastal. Whether the northwest Atlantic population is discrete from those fished elsewhere in the northwestern or northeastern Atlantic is currently unresolved. There exists one tag return of a male tagged off Browns Bank (Nova Scotia) in 1966 and returned from Spain in 1973. At present, because of their general offshore distribution, sperm whales are less likely to be impacted by humans and those impacts that do occur are less likely to be recorded. There has been no complete analysis and reporting of existing data on this topic for the western North Atlantic. Only a single record exists in the present NEFSC by-catch database. In July 1990, a sperm whale was entangled and subsequently released (injured) from a swordfish drift net near the continental shelf edge on southern Georges Bank.

Total annual estimated average fishery-related mortality and serious injury to this stock in the U.S. Atlantic EEZ during 1989-1993 was 1.6 sperm whales (CV = 2.72). There is no information on incidental mortality in fisheries in Canadian waters. Total fishery-related mortality and serious injury for this stock is greater than 10% of the calculated PBR, based on limited survey data, 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. One sperm whale was entangled in this fishery and released showing signs of serious injury. Annual fishery-related mortality and serious injury was estimated using the aggregated catch rates, by strata (Northridge, in review). Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 2.2 sperm whales in 1989 (2.43), 4.4 in 1990 (1.77), 0.5 in 1991 (1.49), 0.4 (1.44) in 1992, and 0.3 (1.37) in 1993.

STATUS OF STOCK

The status of this stock relative to OSP is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine population trends. The current stock abundance estimate was based upon a small portion of the known stock range within the U.S. EEZ. This is believed to be an underestimate and estimates of stock size based on surveys of the entire range are expected to result in a higher calculated PBR. This is a strategic stock because the species is listed as endangered under the ESA and estimated annual fishery-related mortality and serious injury exceeds PBR

REFERENCES

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.

Best, P. B. 1974. Biology of the sperm whale. Pages 53-81 *in* W. E. Schevill (editor), The whale problem: A status report. Harvard University Press, Cambridge, Massachusetts, 419 pp.

Best, P. B. 1979. Social organization in sperm whales, *Physeter macrocephalus*. Pages 227-289 *in* H. E. Winn and B. L. Olla (editors), Behavior of marine animals, Vol. 3: Cetaceans. Plenum Press, New York.

Buckland, S. T., D. R. Andersen, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman and Hall, New York, 442 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.

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.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Lockyer, C. 1981. Estimates of growth and energy budget for the sperm whale. Pages 491-504 *in* Mammals in the seas, III. FAO Fish. Ser. No. 5. FAO, Rome, 504 pp.

Mitchell, E. and V. M. Kozicki. 1984. Reproductive condition of male sperm whales, *Physeter macrocephalus*, taken off Nova Scotia. Rep. Int. Whal. Commn. (Special Issue 6): 243-252.

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.

Schmidly, D. J. 1981. Marine mammals of the southeastern United States and the Gulf of Mexico. Department of the Interior, U.S. Fish and Wildlife Service Publication FWS/OBS-80/41, Washington, DC, 166 pp.

Waring, G. T., C. P. Fairfield, C. M. Ruhsam, and M. Sano. 1993. Sperm whales associated with Gulf Stream features off the north-eastern USA shelf. Fish. Oceanogr. 2(2): 101-105

Watkins, W. A., K. E. Moore, and P. Tyack. 1985. Sperm whale acoustic behavior in the southeast Caribbean. Cetology 49: 1-15.

DWARF SPERM WHALE (*Kogia simus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The dwarf sperm whale (*Kogia simus*) and the pygmy sperm whale (*K. breviceps*) appear to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily along the continental shelf edge and over the deeper waters off the continental shelf (Mullin et al. 1991; NMFS unpublished data). Pygmy sperm whales and dwarf sperm whales are difficult to distinguish and sightings of either species are often categorized as *Kogia* spp. There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during a 1992 winter, visual sampling, line-transect vessel survey of the U.S. Atlantic Exclusive Economic Zone (EEZ) waters between Miami, Florida, and Cape Hatteras, North Carolina. Abundance was estimated for both species combined because the majority of sightings were not identified to species, and both species are known to occur in the area. The estimated abundance of dwarf sperm whales and pygmy sperm whales combined for the 1992 surveys was 420 animals (coefficient of variation, CV = 0.60) (Hansen et al. 1994). Dwarf sperm whale abundance cannot be estimated due to uncertainty of species identification of sightings.

Minimum Population Estimate

A minimum population size could not be estimated because of the uncertainty in species identification.

Current Population Trend

No information was available evaluate trends in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was not calculated because the minimum population size cannot be estimated.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of dwarf sperm whales in the U.S. Atlantic EEZ is unknown. Available information indicates there is likely little, if any, fisheries interaction with dwarf sperm whales in the U.S. Atlantic EEZ. It is not known whether total fishery-related mortality and serious injury for this stock is less than 10% of PBR and can therefore be considered insignificant and approaching zero mortality and serious injury rate, because PBR cannot be calculated. 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.

Fisheries Information

Current data sources include the Northeast Fisheries Science Center (NEFSC) Weigh Out Data Program and Sea Sampling Observer Program initiated in 1989. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries. 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 provides observer coverage of vessels fishing south of Cape Hatteras.

By-catch has been observed by NMFS Sea Samplers in the swordfish/tuna/shark drift gillnet fishery, but no mortalities have been documented in the Atlantic swordfish/tuna/shark longline, Atlantic swordfish/tuna/shark pair trawl, New England multispecies sink gillnet and Gulf of Maine groundfish trawl fisheries.

Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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. There were no reports of mortality or serious injury to dwarf sperm whales attributable to this fishery.

There were no reports of incidental mortality or injury of dwarf sperm whales associated with the U.S. longline swordfish/tuna fishery which has been monitored at approximately 5% coverage by NMFS observers since 1992. However, other fisheries which operate in areas frequented by dwarf sperm whales were not monitored by observers.

There were no documented strandings of dwarf sperm whales along the U.S. Atlantic coast during 1987-present which were classified as likely caused by fishery interactions. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Other Mortality

At least 19 dwarf sperm whale strandings have been documented along the U.S. Atlantic coast between Cape Hatteras, North Carolina, and Miami, Florida, during 1987-1994. Three of the stranded animals had plastic, or a plastic bag or bags in their stomachs, and one of these three had possible propeller cuts on or near the flukes.

STATUS OF STOCK

The status of this stock relative to OSP is unknown. This species is not listed as endangered or threatened under the Endangered Species Act. There is insufficient information with which to assess population trends. Upon the advice of the Atlantic Scientific Review Group this stock has been designated a strategic stock because PBR cannot been determined and there is an unknown amount of possible human-caused mortality from the ingestion of marine debris such as plastic bags and from possible boat strikes.

REFERENCES

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Caldwell, D. K. and M. C. Caldwell 1989. Pygmy sperm whale *Kogia breviceps* (de Blainville, 1838): dwarf sperm whale *Kogia simus* Owen, 1866. Pages 235-260 *in* S. H. Ridgway and R. Harrison, Handbook of marine mammals, Vol. 4: river dolphins and the larger toothed whales. Academic Press, San Diego.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1994. Preliminary estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-93/94-58.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana, 108 pp.

PYGMY SPERM WHALE (*Kogia breviceps*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The dwarf sperm whale (*Kogia breviceps*) and the pygmy sperm whale (*K. simus*) appear to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily along the continental shelf edge and over the deeper waters off the continental shelf (Mullin et al. 1991; Southeast Fisheries Science Center unpublished data). Pygmy sperm whales and dwarf sperm whales are difficult to distinguish and sightings of either species are often categorized as *Kogia* spp. There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during a 1992 winter, visual sampling, line-transect vessel survey of the U.S. Atlantic Exclusive Economic Zone (EEZ) waters between Miami, Florida, and Cape Hatteras, North Carolina. Abundance was estimated for both species combined because the majority of sightings were not identified to species, and both species are known to occur in the area. The estimated abundance of dwarf sperm whales and pygmy sperm whales combined for the 1992 surveys was 420 animals (coefficient of variation, CV = 0.60) (Hansen et al. 1994). Pygmy sperm whale abundance cannot be estimated due to uncertainty of species identification of sightings.

Minimum Population Estimate

A minimum population size could not be estimated because of the uncertainty in species identification.

Current Population Trend

No information was available to evaluate trends in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was not calculated because the minimum population estimate cannot be calculated.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of pygmy sperm whales in the U.S. Atlantic EEZ is unknown. Available information indicates there is likely little, if any, fisheries interaction with pygmy sperm whales in the U.S. Atlantic EEZ.

There were no documented strandings of pygmy sperm whales along the U.S. Atlantic coast during 1987-present which were classified as likely caused by fishery interactions. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

It is not known whether total fishery-related mortality and serious injury for this stock is less than 10% of PBR and can therefore be considered insignificant and approaching zero mortality and serious injury rate, because PBR cannot be calculated. 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.

Fisheries Information

Current data sources include the Northeast Fisheries Science Center (NEFSC) Weighout Data Program and Sea Sampling Observer Program initiated in 1989. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries. 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 provides observer coverage of vessels fishing south of Cape Hatteras.

By-catch has been observed by NMFS Sea Samplers in the swordfish/tuna/shark drift gillnet fishery, but no mortalities have been documented in the Atlantic swordfish/tuna/shark longline, Atlantic swordfish/tuna/shark pair trawl, New England multispecies sink gillnet and Gulf of Maine groundfish trawl fisheries.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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. There were no reports of fishery-related mortality or serious injury to pygmy sperm whales attributable to this fishery.

There were no reports of incidental mortality or injury of pygmy sperm whales associated with the U.S. swordfish/tuna longline fishery which has been monitored at approximately 5% coverage by NMFS observers since 1992. However, other fisheries which operate in areas frequented by pygmy sperm whales were not monitored by observers.

Other Mortality

At least 142 pygmy sperm whale strandings were documented along the U.S. Atlantic coast between Cape Hatteras, North Carolina, and Miami, Florida, during 1987-1994. Two of the stranded animals had plastic, or a plastic bag or bags in their stomachs, and one additional animal had possible propeller cuts on it's flukes.

STATUS OF STOCK

The status of this stock relative to OSP is unknown. This species is not listed as endangered or threatened under the Endangered Species Act. There is insufficient information with which to assess population trends. Upon the advice of the Atlantic Scientific Review Group this stock has been designated a strategic stock because PBR cannot been determined and there is an unknown amount of possible human-caused mortality from the ingestion of marine debris such as plastic bags and from possible boat strikes.

REFERENCES

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Caldwell, D. K. and M. C. Caldwell 1989. Pygmy sperm whale *Kogia breviceps* (de Blainville, 1838): dwarf sperm whale *Kogia simus* Owen, 1866. Pages 235-260 *in* S. H. Ridgway and R. Harrison, Handbook of marine mammals, Vol. 4: river dolphins and the larger toothed whales. Academic Press, San Diego.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1994. Preliminary estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-93/94-58.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana, 108 pp.

KILLER WHALE (*Orcinus orca*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Killer whales are characterized as uncommon or rare in waters of the U.S. Atlantic Exclusive Economic Zone (EEZ) (Katona et al. 1988). The 12 killer whale sightings constituted 0.1% of the 11,156 cetacean sightings in the 1978-81 CeTAP surveys (CeTAP 1982). The same is true for eastern Canadian waters, where the species has been described as relatively uncommon and numerically few (Mitchell and Reeves 1988). Their distribution, however, extends from the Arctic ice-edge to the West Indies. They are normally found in small groups, although 40 animals were reported from the southern Gulf of Maine in September 1979, and 29 animals in Massachusetts Bay in August 1986 (Katona et al. 1988). In the U.S. Atlantic EEZ, while their occurrence is unpredictable, they do occur in fishing areas, perhaps coincident with tuna, in warm seasons (Katona et al. 1988; NMFS unpublished data). In an extensive analysis of historical whaling records, Reeves and Mitchell (1988) plotted the distribution of killer whales in offshore and mid-ocean areas. Their results suggest that the offshore areas need to be considered in present-day distribution, movements, and stock relationships.

Stock definition is unknown. Results from other areas (e.g., the Pacific Northwest and Norway) suggest that social structure and territoriality may be important.

POPULATION SIZE

The total number of killer whales off the eastern U.S. coast is unknown.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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

No PBR can be estimated for this species at this time, because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY

In 1994, one killer whale was caught in the Gulf of Maine sink gillnet fishery but released alive. No takes were documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Fishery Information

In 1992, there were approximately 349 vessels (full and part time) in the New England multispecies gillnet fishery (Walden, in review). Observer coverage in trips had been 1%, 6%, 7.5%, and 5% for the years 1990 to 1993. The fishery has been observed in the Gulf of Maine and in southern New England. Though the data have not been analyzed, the fishery in 1994 (the only year with by-catch) is probably similar to that in the past.

Because there are no observed mortalities or serious injury between 1990 and 1993, the total fishery-related mortality and serious injury for this stock is 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.

STATUS OF STOCK

The status of killer whales relative to OSP in U.S. Atlantic coast waters is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. This is not a strategic stock because, although PBR could not be calculated, there is no evidence of human-induced mortality.

REFERENCES

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

Katona, S. K., J. A. Beard, P. E. Girton, and F. Wenzel. 1988. Killer whales (*Orcinus orca*) from the Bay of Fundy to the Equator, including the Gulf of Mexico. Rit. Fiskideild. 9: 205-224.

Mitchell, E. and R. R. Reeves. 1988. Records of killer whales in the western North Atlantic, with emphasis on eastern Canadian waters. Rit. Fiskideild. 9: 161-193.

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. and E. Mitchell. 1988. Killer whale sightings and takes by American pelagic whalers in the North Atlantic. Rit. Fiskideild. 9: 7-23

Walden, J. In review. Results of the Gulf of Maine gillnet survey 1989-92. NOAA, NMFS, NEFSC [Northeast Fisheries Science Center] Ref. Doc., Woods Hole, Massachusetts.

PYGMY KILLER WHALE (*Feresa attenuata*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy killer whale is distributed worldwide in tropical and subtropical waters (Ross and Leatherwood 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf (NMFS unpublished data). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

A single sighting of this species was made during a 1992 winter, visual sampling, line-transect vessel survey of the U.S. Atlantic Exclusive Economic Zone (EEZ) from Miami, Florida, to Cape Hatteras, North Carolina (Hansen et al. 1994). This sighting, of a herd of six animals, was not made during visual sampling effort; therefore, the sighting could not be used to estimate abundance of pygmy killer whales, but it does confirm the presence of this species in the U.S. Atlantic EEZ.

Minimum Population Estimate

The minimum population estimate based on the count of animals in the single sighting, was six pygmy killer whales (Hansen et al. 1994).

Current Population Trend

No information was available to evaluate trends in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. The resulting PBR for this stock is 0.1 pygmy killer whale.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of pygmy killer whales in the U.S. Atlantic EEZ is unknown; however, there has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell and Caldwell 1971). Available information indicates there likely is little, if any, fisheries interaction with pygmy killer whales in the U.S. Atlantic EEZ. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There have been no documented strandings of pygmy killer whales in the along the U.S. Atlantic coast during 1987-present which have been classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Current data sources include the Northeast Fisheries Science Center (NEFSC) Weighout Data Program and Sea Sampling Observer Program initiated in 1989. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries. 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 provides observer coverage of vessels fishing south of Cape Hatteras.

By-catch has been observed by NMFS Sea Samplers in the swordfish/tuna/shark drift gillnet fishery, but no mortalities have been documented in the Atlantic swordfish/tuna/shark longline, Atlantic swordfish/tuna/shark pair trawl, New England multispecies sink gillnet and Gulf of Maine groundfish trawl fisheries.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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. There were no reports of fishery-related mortality or serious injury to pygmy killer whales attributable to this fishery.

There have been no reports of incidental mortality or injury of pygmy killer whales associated with the U.S. longline swordfish/tuna fishery which has been monitored at approximately 5% coverage by NMFS observers since 1992; however, there may be other fisheries which operate in areas frequented by pygmy killer whales which are not monitored by NMFS observers.

Other Mortality

This stock may be subjected to human-induced mortality caused by habitat degradation (e.g., industrial and agricultural pollution) and indirect effects of fisheries on prey. There have been, however, no studies to date which have determined the amount, if any, of indirect human-induced mortality resulting from habitat degradation or competition for prey.

STATUS OF STOCK

The status of pygmy killer whales relative to OSP in U.S. Atlantic coast waters is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. This is not a strategic stock because there is no known fishery-related mortality or serious injury.

REFERENCES

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.

Caldwell, D. K. and M. C. Caldwell. 1971. The pygmy killer whale, *Feresa attenuata*, in the western Atlantic, with a summary of world records. J. Mamm. 52:206-209.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1994. Preliminary estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys, and of selected cetacean species in the U.S. Atlantic Exclusive Economic Zone from vessel surveys from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-93/94-58

Ross, G. J. B. and S. Leatherwood. 1994. Pygmy killer whale *Feresa attenuata* (Gray, 1874). Pages 387-404 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, San Diego, 418 pp.

NORTHERN BOTTLENOSE WHALE (*Hyperoodon ampullatus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern bottlenose whales are characterized as extremely uncommon or rare in waters of the U.S. Atlantic Exclusive Economic Zone. The two sightings of three individuals constituted less than 0.1% of the 11,156 cetacean sightings in the 1978-82 CeTAP surveys. Both sightings were in the spring, along the 2,000 m isobath (CeTAP 1982).

Northern bottlenose whales are distributed in the North Atlantic from Nova Scotia to about 70° in the Davis Strait, along the east coast of Greenland to 77° and from England to the west coast of Spitzbergen. It is largely a deep-water species and is very seldom found in waters less than 2,000 m deep (reviewed by Mead 1989).

There are two main centers of bottlenose whale distribution in the western north Atlantic, one in the area called "The Gully" just north of Sable Island, Nova Scotia, and the other in Davis Strait off northern Labrador. Studies at the entrance to the Gully from 1988-1991 identified 208 individuals and estimated the local population size at a few hundred individuals (Faucher et al. 1991). Mitchell and Kozicki (1975) documented stranding records in the Bay of Fundy and as far south as Rhode Island. Stock definition is unknown.

POPULATION SIZE

The total number of northern bottlenose whales off the eastern U.S. coast is unknown.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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

No PBR can be estimated for this species at this time, because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY

No mortalities have been reported in U.S. waters. A fishery for northern bottlenose whales existed in Canadian waters during both the 1800s and 1900s. Its development was due to the discovery that bottlenose whales contained spermaceti. A Norwegian fishery expanded from east to west (Labrador and Newfoundland) in several episodes. The fishery peaked in 1965. Decreasing catches led to the cessation of the fishery in the 1970s, and provided evidence that the population was depleted. A small fishery operated by Canadian whalers from Nova Scotia operated in the Gully, and took 87 animals from 1962-1967 (Mead 1989; Mitchell 1977).

Fishery Information

Because there are no observed mortalities or serious injury, no fishery information is presented. The total fishery-related mortality and serious injury for this stock is 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.

STATUS OF STOCK

The status of northern bottlenose whales relative to OSP in U.S. Atlantic coast waters is unknown; however, a depletion in Canadian waters in the 1970s may have impacted U.S. distribution and may be relevant to current status in U.S. waters. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. This is not a strategic stock because there are no recent records of fishery-related mortality or serious injury.

REFERENCES

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.

Faucher, A. and H. Whitehead. 1991. Population biology, social structure, and movements of northern bottlenose whales (*Hyperoodon ampullatus*) in the Gully, Nova Scotia. Paper presented at Ninth Biennial conference on the Biology of Marine Mammals, 5-9 December 1991, Chicago, Illinois.

Mead, J. G. 1989. Bottlenose whales. Pages 321-348 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Volume 4: River dolphins and the larger toothed whales,. Academic Press, New York.

Mitchell, E. D. 1977. Evidence that the northern bottlenose whale is depleted. Rep. Int. Whal. Commn. 27: 195-203.

Mitchell, E. D. and V. M. Kozicki. 1975. Autumn stranding of a northern bottlenose whale (*Hyperoodon ampullatus)* in the Bay of Fundy. J. Fish. Res. Bd. Can. 32: 1019-1040.

CUVIER'S BEAKED WHALE (*Ziphius cavirostris*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of Cuvier's beaked whales is poorly known, and is based mainly on stranding records (Leatherwood et al. 1976). Strandings have been reported from Nova Scotia along the eastern U.S. coast south to Florida, around the Gulf of Mexico, and within the Caribbean (Leatherwood et al. 1976; CeTAP 1982; Heyning 1989; Houston 1990). Stock structure in the western North Atlantic is unknown.

Cuvier's beaked whale sightings have occurred principally along the continental shelf edge in the mid-Atlantic region off the northeast U.S. coast (CeTAP 1982; NMFS unpublished data). Most sightings were in late spring or summer. Based on sighting data, this species is a rare inhabitant of waters off the northeast U.S. coast (CeTAP 1982).

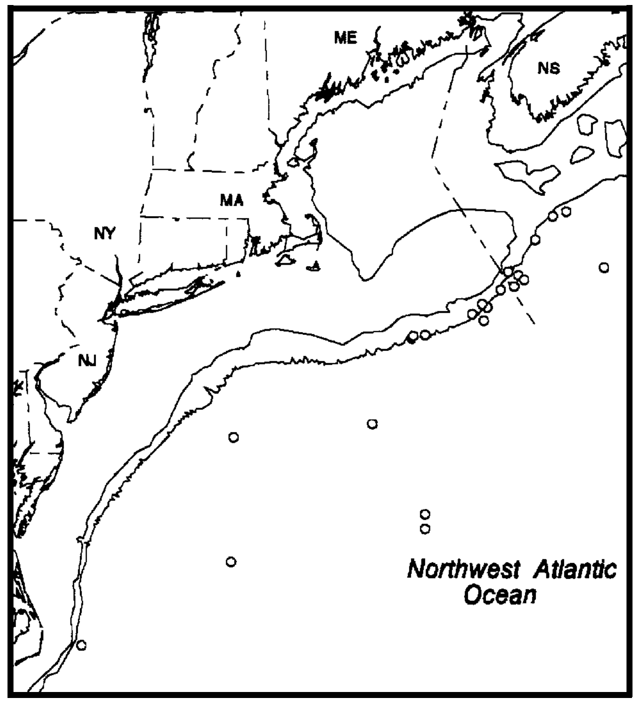


Figure 1. *Distribution of beaked whale sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

The total number of Cuvier's beaked whales off the eastern U.S. coast is unknown. Seasonal abundance estimates reported in CeTAP (1982) are based on "probable" sightings; therefore, population size could not be estimated.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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).

Some of the life history parameters which have been estimated include: length at birth is 2 to 3 m, length at sexual maturity 6.1 m for females, and 5.5 m for males, maximum age for females were 30 growth layer groups (GLG's) and for males was 36 GLG's, which may be annual layers (Mitchell 1975; Mead 1984; Houston 1990).

POTENTIAL BIOLOGICAL REMOVAL

No PBR can be estimated for this species at this time, because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Beaked whales (many unidentified as to species) have been killed in the pelagic drift gillnet fishery off the U.S. Atlantic coast. While there are no reported takes in other continental shelf edge fisheries (i.e., pelagic pair trawl, longline), observer coverage in these fisheries is low and because beaked whales occupy this habitat, unreported takes may have occurred.

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic Exclusive Economic Zone (EEZ) might have been subject to the observed fishery-related mortality and serious injury. Twenty-two fishery-related beaked whale mortalities were observed between 1989 and 1993. The 1989-1993 total average estimated annual fishery-related mortality of beaked whales in the U.S. EEZ was 34 (CV = 0.69). Although PBR cannot be determined, the total fishery-related mortality and serious injury for this stock is not considered to be 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.

Fisheries Information

There is no historical information available that documents incidental mortality in either U.S. or Canadian Atlantic coast fisheries.

Current data sources include the Northeast Fisheries Science Center (NEFSC) Weigh Out Data Program and Sea Sampling Observer Program initiated in 1989. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries. These logbooks are maintained at Southeast Fisheries Science Center (SEFSC). 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. Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

By-catch has been observed by NMFS Sea Samplers in the swordfish/tuna/shark drift gillnet fishery, but no mortalities have been documented in the Atlantic swordfish/tuna/shark longline, Atlantic swordfish/tuna/shark pair trawl, New England multispecies sink gillnet, or New England groundfish trawl observed fisheries.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). By-catch of beaked whales has only occurred from Georges Canyon to Hydrographer Canyon along the continental shelf break and continental slope during July to October. Twenty-two fishery-related beaked whale mortalities were observed between 1989 and 1993. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.49), 76 in 1990 (0.56), 13 in 1991 (0.57), 9.7 in 1992 (0.53), and 12 in 1993 (0.32).

STATUS OF STOCK

The status of Cuvier's beaked whale relative to OSP in U.S. Atlantic coast waters is unknown. This species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine population trends and the level of human-caused mortality and serious injury is unknown because of uncertainty regarding species identification in observed fisheries. If one were to assume that the incidental fisheries mortality of the four *Mesoplodon* spp. and *Z. cavirostris* was random with respect to species (i.e., in proportion to their relative abundance), then the minimum population estimate for all of those stocks would need to sum to at least 3,400 in order for an annual mortality of 34 animals not to exceed the PBR of any one of these species. Because an assumption of unselective incidental fishing mortality is probably overly optimistic and represents a best case situation, it is likely that a combined minimum population estimate of substantially greater than 3,400 would be necessary for an annual mortality of 34 to not exceed the PBR of any one of these five stocks. The largest recent abundance estimate available for beaked whales in the western North Atlantic was 612 (CV = 0.73), which would result in a minimum population estimate of 353 beaked whales; however, this estimate does not include a correction factor for submerged animals which may be substantial. This is a strategic stock because of uncertainty regarding stock size and evidence of fishery-related mortality and serious injury.

REFERENCES

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.

Heyning, J. E. 1989. Cuvier's beaked whale, *Ziphius cavirostris* G. Cuvier, 1823. Pages 289-308 *in* S. H. Ridgway and R. Harrison (editors), Handbook of Marine Mammals, Vol. 4: River dolphins and larger toothed whales. Academic Press, London, 442 pp.

Houston, J. 1990. Status of Cuvier's Beaked Whale, *Ziphius cavirostris*, in Canada. Can. Fld. Nat. 105(2): 215-218.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 pp.

Mead, J. G. 1984. Survey of reproductive data for the beaked whales (*Ziphiidae*). Rep. Int. Whal. Commn. (Special Issue 6): 91-96.

Mitchell, E. D. (editor). 1975. Review of the biology and fisheries for smaller cetaceans. Report of the meeting on smaller cetaceans. Int. Whal. Commn. J. Fish. Res. Bd. Can. 32(7): 875-1240.

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.

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.

TRUE'S BEAKED WHALE (*Mesoplodon mirus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the genus Mesoplodon, there are four species of beaked whales in the northwest Atlantic. These include True's beaked whale, *Mesoplodon mirus*; Gervais' beaked whale, *M. europaeus*; Blainville's beaked whale, *M. densirostris*; and Sowerby's beaked whale, *M. bidens*. These species are difficult to identify to the species level at sea; therefore, much of the available characterization for beaked whales is to genus level only.

The distribution of *Mesoplodon* spp. in the northwest Atlantic is known principally from stranding records (Mead 1989). Off the northeast U.S. coast, beaked whale (*Mesoplodon* spp.) sightings have occurred principally along the southern edge of Georges Bank (CeTAP, 1982; NMFS unpublished data). Most sightings were in late spring and summer. In addition, beaked whales were also sighted in Gulf Stream features during NEFSC 1990-1994 surveys (NMFS unpublished data).

True's beaked whale is a temperate-water species that has been reported from Cape Breton Island, Nova Scotia, to the Bahamas (Leatherwood et al. 1976, Mead 1989). It is considered rare in Canadian waters (Houston 1989).

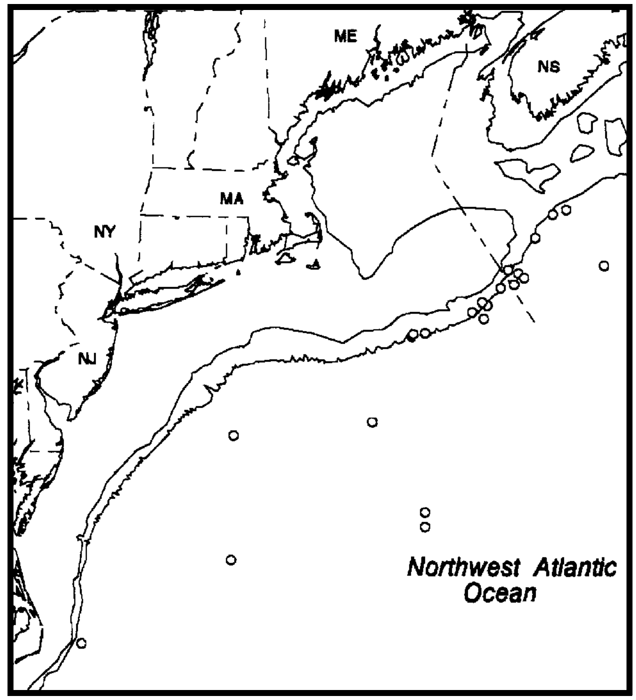


Figure 1. *Distribution of beaked whale sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

Population size can presently be described only for undifferentiated *Mesoplodon* spp. The total number of beaked whales (*Mesoplodon* spp.) along the eastern U.S. or Canadian coasts is unknown, though several estimates from select regions of the habitat do exist. Seasonal abundance estimates are available from an aerial line transect survey program conducted in the continental shelf waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982), just after cessation of extensive foreign fishing operations in this region. An abundance estimate based on CeTAP summer data is 120 (CV = 0.71). This estimate was not corrected for g(0), the probability of detecting an animal group on the trackline.

Abundance estimates were also derived using data collected during an autumn 1991 aerial survey in the CeTAP study area (NMFS unpublished data), which included an interplatform experiment between a Twin Otter and an AT-11), and from several fine-scale ship line transect surveys (August 1990, June-July 1991, June-July 1993, and August 1994) conducted in continental shelf edge and deeper oceanic waters (NMFS unpublished data). The data were analyzed using DISTANCE (Buckland et al. 1993; Laake et al. 1993) where the CV was estimated using the bootstrap lognormal method. For the aerial and shipboard surveys, sightings were almost exclusively in the continental shelf edge and continental slope water areas. Abundance estimates from the 1991 aerial survey were 612 (CV = 0.73) and 370 (CV = 0.65), respectively, for the AT-11 and Twin Otter. Data were not pooled, because the interplatform calibration analysis has not been conducted. Furthermore, these estimates are not fully comparable to the CeTAP estimates, because the 1991 data are from a single survey, August to October, while the CeTAP estimates were based on data pooled over several years of seasonal surveys.

An abundance estimate from the August 1990 shipboard survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank, was 442 (CV = 0.51). The 1991 survey estimate, based principally on sighting effort conducted between the 200 and 2,000 meter isobaths from Cape Hatteras to Georges Bank is 262 beaked whales (CV = 0.99). The estimate for the 1993 survey, conducted principally between the 200 and 2,000 meter isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southwestern edge of the Scotian Shelf was 330 beaked whales (CV = 0.66). The 1994 estimate, based on survey effort within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank was 99 beaked whales (CV = 0.64). Because the number of beaked whale sightings in each survey were extremely low (3 to 10), and their sightability and behavior preclude pooling with other cetaceans, the abundance estimates are based on small sample sizes. Therefore, the above abundance estimates should be viewed with caution.

Although the 1990-1994 surveys did not sample exactly the same areas or encompass the entire beaked whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-94 data suggest that, seasonally, at least several hundred beaked whales are occupying these waters, highest levels of abundance in the Georges Bank region. This is consistent with the earlier CeTAP results. Recent results suggest that beaked whale abundance may be highest in association with Gulf Stream and warm-core ring features. However, at present there are no estimates of total abundance for beaked whales in the western North Atlantic.

Because the estimates presented here were not dive-time corrected, they are likely negatively biased and probably underestimate actual abundance. Given that *Mesoplodon* spp. prefers deep-water habitats (Mead 1989) the bias may be substantial.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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

No PBR can be estimated for this species at this time, because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Beaked whales (many unidentified as to species) have been killed in the pelagic drift gillnet fishery off the U.S. Atlantic coast. While there are no reported takes in other continental shelf edge fisheries (i.e., pelagic pair trawl, longline), observer coverage in these fisheries is low and because beaked whales occupy this habitat, unreported takes may have occurred.

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic Exclusive Economic Zone (EEZ) might have been subject to the observed fishery-related mortality and serious injury. Twenty-two fishery-related beaked whale mortalities were observed between 1989 and 1993. The 1989-1993 total average estimated annual fishery-related mortality of beaked whales in the U.S. EEZ was 34 (CV = 0.69). Although PBR cannot be determined, the total fishery-related mortality and serious injury for this stock is not considered to be 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.

Fisheries Information

There is no historical information available that documents incidental mortality in either U.S. or Canadian Atlantic coast fisheries (Read 1994).

Current data sources include the Northeast Fisheries Science Center (NEFSC) Weigh Out Data Program and Sea Sampling Observer Program initiated in 1989. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries. These logbooks are maintained at Southeast Fisheries Science Center (SEFSC). 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. Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

By-catch has been observed by NMFS Sea Samplers in the swordfish/tuna/shark drift gillnet fishery, but no mortalities have been documented in the Atlantic swordfish/tuna/shark longline, Atlantic swordfish/tuna/shark pair trawl, New England multispecies sink gillnet, or New England groundfish trawl observed fisheries.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). By-catch of beaked whales has only occurred from Georges Canyon to Hydrographer Canyon along the continental shelf break and continental slope during July to October. Twenty-two fishery-related beaked whale mortalities were observed between 1989 and 1993. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.49), 76 in 1990 (0.56), 13 in 1991 (0.57), 9.7 in 1992 (0.53), and 12 in 1993 (0.32). The 1989-1993 average estimated annual fishery-related mortality of beaked whales was 34 (CV = 0.69).

STATUS OF STOCK

The status of True's beaked whale relative to OSP in U.S. Atlantic coast waters is unknown. This species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine population trends and the level of human-caused mortality and serious injury is unknown because of uncertainty regarding species identification in observed fisheries. If one were to assume that the incidental fisheries mortality of the four *Mesoplodon* spp. and *Z. cavirostris* was random with respect to species (i.e., in proportion to their relative abundance), then the minimum population estimate for all of those stocks would need to sum to at least 3,400 in order for an annual mortality of 34 animals not to exceed the PBR of any one of these species. Because an assumption of unselective incidental fishing mortality is probably overly optimistic and represents a best case situation, it is likely that a combined minimum population estimate of substantially greater than 3,400 would be necessary for an annual mortality of 34 to not exceed the PBR of any one of these five stocks. The largest recent abundance estimate available for beaked whales in the western North Atlantic was 612 (CV = 0.73), which would result in a minimum population estimate of 353 beaked whales; however, this estimate does not include a correction factor for submerged animals which may be substantial. This is a strategic stock because of uncertainty regarding stock size and evidence of fishery-related mortality and serious injury.

REFERENCES

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.

Buckland, S. T., D. R. Andersen, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman and Hall, New York, 446 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.

Houston, J. 1989. Status of True's Beaked Whale, *Mesoplodon mirus*, in Canada. Can. Fld. Nat. 104(1): 135-137.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 pp.

Mead, J. G. 1989. Beaked whales of the genus *Mesoplodon*. Pages 349-430 *in* S. H., Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 4: River Dolphins and toothed whales. Academic press, San Diego, 442 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.

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.

GERVAIS' BEAKED WHALE (*Mesoplodon europaeus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the genus Mesoplodon, there are four species of beaked whales in the northwest Atlantic. These include Gervais' beaked whale, *Mesoplodon europaeus*; True's beaked whale, *M. mirus*; Blainville's beaked whale, *M. densirostris*; and Sowerby's beaked whale, *M. bidens*. These species are difficult to identify to the species level at sea; therefore, much of the available characterization for beaked whales is to genus level only.

The distribution of *Mesoplodon* spp. in the northwest Atlantic is known principally from stranding records (Mead 1989). Off the northeast U.S. coast, beaked whale (*Mesoplodon* spp.) sightings have occurred principally along the southern edge of Georges Bank (CeTAP 1982; NMFS unpublished data). Most sightings were in late spring and summer. In addition, beaked whales were also sighted in Gulf Stream features during NEFSC 1990-1994 surveys (NMFS unpublished data).

Gervais's beaked whales are believed to be principally oceanic, and strandings have been reported from the mid-Atlantic Bight to Florida, into the Caribbean and the Gulf of Mexico (Leatherwood et al. 1976; Mead 1989). This is the commonest species of *Mesoplodon* stranded along the U.S. Atlantic coast. The northernmost stranding was off New York (Mead 1989).

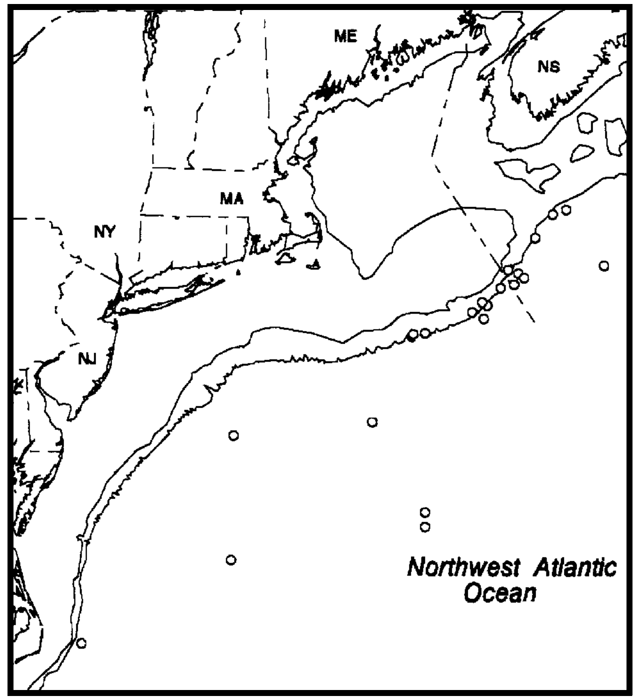


Figure 1. *Distribution of beaked whale sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

Population size can presently be described only for undifferentiated *Mesoplodon* spp. The total number of beaked whales (*Mesoplodon* spp.) along the eastern U.S. or Canadian coasts are unknown, though several estimates from select regions of the habitat do exist. Seasonal abundance estimates are available from an aerial line transect survey program conducted in the continental shelf waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982), just after cessation of extensive foreign fishing operations in this region. An abundance estimate based on CeTAP summer data is 120 (CV = 0.71). This estimate was not corrected for g(0), the probability of detecting an animal group on the trackline.

Abundance estimates were also derived using data collected during an autumn 1991 aerial line transect survey in the CeTAP study area (NMFS unpublished data), which included an interplatform experiment between a Twin Otter and an AT-11), and from several fine-scale ship line transect surveys (August 1990, June-July 1991, June-July 1993, and August 1994) conducted in continental shelf edge and deeper oceanic waters (NMFS unpublished data). For the aerial and shipboard surveys, sightings were almost exclusively in the continental shelf edge and continental slope water areas. The data were analyzed using DISTANCE (Buckland et al. 1993; Laake et al. 1993) where the CV was estimated using the bootstrap lognormal method. Abundance estimates from the 1991 aerial survey were 612 (CV = 0.73) and 370 (CV = 0.65), respectively, for the AT-11 and Twin Otter. Data were not pooled, because the interplatform calibration analysis has not been conducted. Furthermore, these estimates are not fully comparable to the CeTAP estimates, because the 1991 data are from a single survey, August to October, while the CeTAP estimates were based on data pooled over several years of seasonal surveys.

An abundance estimate from the August 1990 survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank, was 442 (CV = 0.51). The 1991 survey estimate, based principally on sighting effort conducted between the 200 and 2,000 meter isobaths from Cape Hatteras to Georges Bank was 262 beaked whales (CV = 0.99). The estimate for the 1993 survey, conducted principally between the 200 and 2,000 meter isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southwestern edge of the Scotian Shelf was 330 beaked whales (CV = 0.66). The 1994 estimate, based on survey effort within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank was 99 beaked whales (CV = 0.64). Because the number of beaked whale sightings in each survey were extremely low (3 to 10), and their sightability and behavior preclude pooling with other cetaceans, the estimates of abundance are based on small sample sizes. Therefore, the above abundance estimates should be viewed with caution.

Although the 1990-1994 surveys did not sample exactly the same areas or encompass the entire beaked whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-94 data suggest that, seasonally, at least several hundred beaked whales are occupying these waters, with highest levels of abundance in the Georges Bank region. This is consistent with the earlier CeTAP results. Recent results suggest that beaked whale abundance may be highest in association with Gulf Stream and warm-core ring features. However, at present there are no estimates of total abundance for beaked whales in the western North Atlantic.

Because the estimates presented here were not dive-time corrected, they are likely negatively biased and probably underestimate actual abundance. Given that *Mesoplodon* spp. prefers deep-water habitats (Mead 1989) the bias may be substantial.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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

No PBR can be estimated for this species at this time, because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Beaked whales (many unidentified as to species) have been killed in the pelagic drift gillnet fishery off the U.S. Atlantic coast. While there are no reported takes in other continental shelf edge fisheries (i.e., pelagic pair trawl, longline), observer coverage in these fisheries is low and because beaked whales occupy this habitat, unreported takes may have occurred.

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic Exclusive Economic Zone (EEZ) might have been subject to the observed fishery-related mortality and serious injury. Twenty-two fishery-related beaked whale mortalities were observed between 1989 and 1993. The 1989-1993 total average estimated annual fishery-related mortality of beaked whales in the U.S. EEZ was 34 (CV = 0.69). Although PBR cannot be determined, the total fishery-related mortality and serious injury for this stock is not considered to be 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.

Fisheries Information

There is no historical information available that documents incidental mortality in either U.S. or Canadian Atlantic coast fisheries (Read, 1994).

Current data sources include the Northeast Fisheries Science Center (NEFSC) Weigh Out Data Program and Sea Sampling Observer Program initiated in 1989. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries. These logbooks are maintained at Southeast Fisheries Science Center (SEFSC). 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. Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

By-catch has been observed by NMFS Sea Samplers in the swordfish/tuna/shark drift gillnet fishery, but no mortalities have been documented in the Atlantic swordfish/tuna/shark longline, Atlantic swordfish/tuna/shark pair trawl, New England multispecies sink gillnet, or New England groundfish trawl observed fisheries.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). By-catch of beaked whales has only occurred from Georges Canyon to Hydrographer Canyon along the continental shelf break and continental slope during July to October. Twenty-two fishery-related beaked whale mortalities were observed between 1989 and 1993. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.49), 76 in 1990 (0.56), 13 in 1991 (0.57), 9.7 in 1992 (0.53), and 12 in 1993 (0.32).

STATUS OF STOCK

The status of Gervais' beaked whale relative to OSP in U.S. Atlantic coast waters is unknown. This species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine population trends and the level of human-caused mortality and serious injury is unknown because of uncertainty regarding species identification in observed fisheries. If one were to assume that the incidental fisheries mortality of the four *Mesoplodon* spp. and *Z. cavirostris* was random with respect to species (i.e., in proportion to their relative abundance), then the minimum population estimate for all of those stocks would need to sum to at least 3,400 in order for an annual mortality of 34 animals not to exceed the PBR of any one of these species. Because an assumption of unselective incidental fishing mortality is probably overly optimistic and represents a best case situation, it is likely that a combined minimum population estimate of substantially greater than 3,400 would be necessary for an annual mortality of 34 to not exceed the PBR of any one of these five stocks. The largest recent abundance estimate available for beaked whales in the western North Atlantic was 612 (CV = 0.73), which would result in a minimum population estimate of 353 beaked whales; however, this estimate does not include a correction factor for submerged animals which may be substantial. This is a strategic stock because of uncertainty regarding stock size and evidence of fishery-related mortality and serious injury.

REFERENCES

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.

Buckland, S. T., D. R. Andersen, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman and Hall, New York, 446 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.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 pp.

Mead, J. G. 1989. Beaked whales of the genus *Mesoplodon*. Pages 349-430 *in* S. H. Ridgeway and R. Harrison (editors), Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, San Diego, 442 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.

1994. Interactions between cetaceans and gillnet and trap fisheries in the Northwest Atlantic. Rep. Int. Whal. Commn. Special Issue 15: 133-147.

BLAINVILLE'S BEAKED WHALE (*Mesoplodon densirostris*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the genus Mesoplodon, there are four species of beaked whales in the northwest Atlantic. These include: Blainville's beaked whale, *Mesoplodon densirostris*; True's beaked whale, *M. mirus*; Gervais' beaked whale, *M. europaeus*; and Sowerby's beaked whale, *M. bidens*. These species are difficult to identify to the species level at sea; therefore, much of the available characterization for beaked whales is to genus level only.

The distribution of *Mesoplodon* spp. in the northwest Atlantic is known principally from stranding records (Mead 1989). Off the northeast U.S. coast, beaked whale (*Mesoplodon* spp.) sightings have occurred principally along the southern edge of Georges Bank (including cow/calf pairs) (CeTAP 1982; Nicolas et al. 1993; NMFS unpublished data). Most sightings were in late spring and summer. In addition, beaked whales were also sighted in Gulf Stream features during NEFSC 1990-1994 surveys (NMFS unpublished data).

Blainville's beaked whales have been reported from southwestern Nova Scotia to Florida, and are believed to be widely but sparsely distributed in tropical to warm-temperate waters (Leatherwood et al. 1976; Mead 1989). There are two records of standings in Nova Scotia which probably represent strays from the Gulf Stream (Mead 1989). They are considered rare in Canadian waters (Houston 1989).

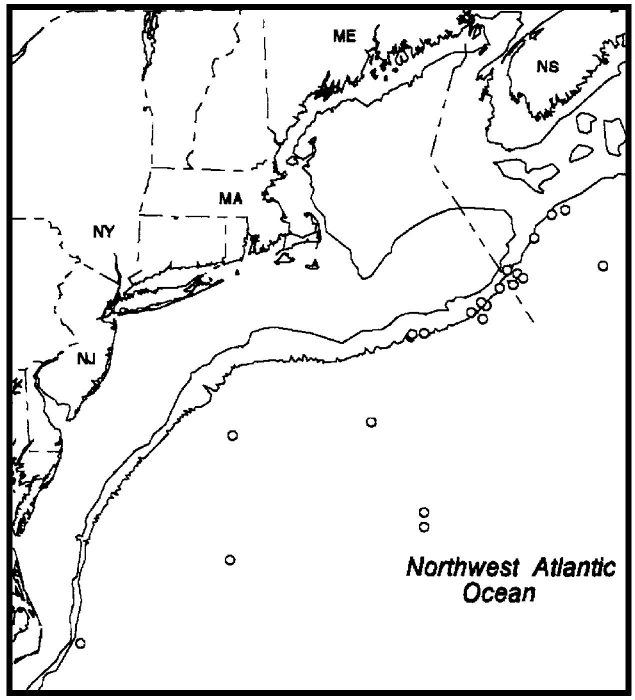


Figure 1. *Distribution of beaked whale sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

Population size can presently be described only for undifferentiated *Mesoplodon* spp. The total number of beaked whales (*Mesoplodon* spp.) along the eastern U.S. or Canadian coasts is unknown, though several estimates from select regions of the habitat do exist. Seasonal abundance estimates are available from an aerial line transect survey program conducted in the continental shelf waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982), just after cessation of extensive foreign fishing operations in this region. An abundance estimate based on CeTAP summer data is 120 (CV = 0.71). This estimate was not corrected for g(0), the probability of detecting an animal group on the trackline.

Abundance estimates were also derived using data collected during an autumn 1991 aerial survey in the CeTAP study area (NMFS unpublished data), which included an interplatform experiment between a Twin Otter and an AT-11), and from several fine-scale ship line transect surveys (August 1990, June-July 1991, June-July 1993, and August 1994) conducted in continental shelf edge and deeper oceanic waters (NMFS unpublished data). For the aerial and shipboard surveys, sightings were almost exclusively in the continental shelf edge and continental slope water areas. The data were analyzed using DISTANCE (Buckland et al. 1993; Laake et al. 1993) where the CV was estimated using the bootstrap lognormal method. Abundance estimates from the 1991 aerial survey were 612 (CV = 0.73) and 370 (CV = 0.65), respectively, for the AT-11 and Twin Otter. Data were not pooled, because the interplatform calibration analysis has not been conducted. Furthermore, these estimates are not fully comparable to the CeTAP estimates, because the 1991 data are from a single survey, August to October, while the CeTAP estimates were based on data pooled over several years of seasonal surveys.

An abundance estimate from the August 1990 shipboard survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank, was 442 (CV = 0.51). The 1991 survey estimate, based principally on sighting effort conducted between the 200 and 2,000 meter isobaths from Cape Hatteras to Georges Bank was 262 beaked whales (CV = 0.99). The estimate for the 1993 survey, conducted principally between the 200 and 2,000 meter isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southwestern edge of the Scotian Shelf was 330 beaked whales (CV = 0.66). The 1994 estimate, based on survey effort within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank was 99 beaked whales (CV = 0.64). Because the number of beaked whale sightings in each survey were extremely low (3 to 10), and their sightability and behavior preclude pooling with other cetaceans, the estimates of abundance are based on small sample sizes. Therefore, the above abundance estimates should be viewed with caution.

Although the 1990-1994 surveys did not sample exactly the same areas or encompass the entire beaked whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-94 data suggest that, seasonally, at least several hundred beaked whales are occupying these waters, with highest levels of abundance in the Georges Bank region. This is consistent with the earlier CeTAP results. Recent results suggest that beaked whale abundance may be highest in association with Gulf Stream and warm-core ring features. However, at present there are no estimates of total abundance for beaked whales in the western North Atlantic.

Because the estimates presented here were not dive-time corrected, they are likely negatively biased and probably underestimate actual abundance. Given that *Mesoplodon* spp. prefers deep-water habitats (Mead 1989) the bias may be substantial.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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

No PBR can be estimated for this species at this time, because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Beaked whales (many unidentified as to species) have been killed in the pelagic drift gillnet fishery off the U.S. Atlantic coast. While there are no reported takes in other continental shelf edge fisheries (i.e., pelagic pair trawl, longline), observer coverage in these fisheries is low and because beaked whales occupy this habitat, unreported takes may have occurred.

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic Exclusive Economic Zone (EEZ) might have been subject to the observed fishery-related mortality and serious injury. Twenty-two fishery-related beaked whale mortalities were observed between 1989 and 1993. The 1989-1993 total average estimated annual fishery-related mortality of beaked whales in the U.S. EEZ was 34 (CV = 0.69). Although PBR cannot be determined, the total fishery-related mortality and serious injury for this stock is not considered to be 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.

Fisheries Information

There is no historical information available that documents incidental mortality in either U.S. or Canadian Atlantic coast fisheries (Read 1994).

Current data sources include the Northeast Fisheries Science Center (NEFSC) Weigh Out Data Program and Sea Sampling Observer Program initiated in 1989. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries. These logbooks are maintained at Southeast Fisheries Science Center (SEFSC). 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. Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

By-catch has been observed by NMFS Sea Samplers in the swordfish/tuna/shark drift gillnet fishery, but no mortalities have been documented in the Atlantic swordfish/tuna/shark longline, Atlantic swordfish/tuna/shark pair trawl, New England multispecies sink gillnet, or New England groundfish trawl observed fisheries.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). By-catch of beaked whales has only occurred from Georges Canyon to Hydrographer Canyon along the continental shelf break and continental slope during July to October. Twenty-two fishery-related beaked whale mortalities were observed between 1989 and 1993. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.49), 76 in 1990 (0.56), 13 in 1991 (0.57), 9.7 in 1992 (0.53), and 12 in 1993 (0.32).

STATUS OF STOCK

The status of Blainville's beaked whale relative to OSP in U.S. Atlantic coast waters is unknown. This species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine population trends and the level of human-caused mortality and serious injury is unknown because of uncertainty regarding species identification in observed fisheries. If one were to assume that the incidental fisheries mortality of the four *Mesoplodon* spp. and *Z. cavirostris* was random with respect to species (i.e., in proportion to their relative abundance), then the minimum population estimate for all of those stocks would need to sum to at least 3,400 in order for an annual mortality of 34 animals not to exceed the PBR of any one of these species. Because an assumption of unselective incidental fishing mortality is probably overly optimistic and represents a best case situation, it is likely that a combined minimum population estimate of substantially greater than 3,400 would be necessary for an annual mortality of 34 to not exceed the PBR of any one of these five stocks. The largest recent abundance estimate available for beaked whales in the western North Atlantic was 612 (CV = 0.73), which would result in a minimum population estimate of 353 beaked whales; however, this estimate does not include a correction factor for submerged animals which may be substantial. This is a strategic stock because of uncertainty regarding stock size and evidence of fishery-related mortality and serious injury.

REFERENCES

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.

Buckland, S. T., D. R. Andersen, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman and Hall, New York, 446 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.

Houston, J. 1989. Status of Blainville's Beaked Whale, *Mesoplodon densirostris*, in Canada. Can. Fld. Nat. 104(1): 117-120.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user’s guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 pp.

Mead, J. G. 1989. Beaked whales of the genus *Mesoplodon*. Pages 349-430 *in* S. H. Ridgeway and R. Harrison (editors), Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, San Diego, 442 pp.

Nicolas, J., A. Williams, G. Repucci. 1993. Observations of beaked whales (*Mesoplodon* spp.) in the western North Atlantic Ocean. Proceedings of the Tenth Biennial Conference on the Biology of Marine Mammals, Nov. 11-15, 1993, Galveston, TX (Abstract).

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.

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.

SOWERBY'S BEAKED WHALE (*Mesoplodon bidens*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the genus Mesoplodon, there are four species of beaked whales in the northwest Atlantic. These include: Sowerby's beaked whale, *Mesoplodon bidens*; True's beaked whale, *M. mirus*; Gervais' beaked whale, *M. europaeus*; and Blainville's beaked whale, *M. densirostris*. These species are difficult to identify to the species level at sea; therefore, much of the available characterization for beaked whales is to genus level only.

The distribution of *Mesoplodon* spp. in the northwest Atlantic is known principally from stranding records (Mead 1989; Lien et al. 1990). Off the northeast U.S. coast, beaked whale (*Mesoplodon* spp.) sightings have occurred principally along the southern edge of Georges Bank (including cow/calf pairs) (CeTAP 1982; Nicolas et al. 1993; NMFS unpublished data). Most sightings were in late spring and summer. In addition, beaked whales were also sighted in Gulf Stream features during NEFSC 1990-1994 surveys (NMFS unpublished data).

Sowerby's beaked whales have been reported from New England waters north to the ice pack, and individuals are seen along the Newfoundland coast in summer (Leatherwood et al. 1976; Mead 1989). Furthermore, a single stranding occurred off the Florida west coast (Mead 1989). This species is considered rare in Canadian waters (Lien et al. 1990).

Figure 1. *Distribution of beaked whale sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

Population size can presently be described only for undifferentiated *Mesoplodon* spp. The total number of beaked whales (*Mesoplodon* spp.) along the eastern U.S. or Canadian coasts is unknown, though several estimates from select regions of the habitat do exist. Seasonal abundance estimates are available from an aerial line transect survey program conducted in the continental shelf waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982), just after cessation of extensive foreign fishing operations in this region. An abundance estimate based on CeTAP summer data is 120 (CV = 0.71). This estimate was not corrected for g(0), the probability of detecting an animal group on the trackline.

Abundance estimates were also derived using data collected during the autumn 1991 aerial survey in the CeTAP study area (NMFS unpublished data), which included an interplatform experiment between a Twin Otter and an AT-11, and from several fine-scale ship line transect surveys (August 1990, June-July 1991, June-July 1993, and August 1994) conducted in continental shelf edge and deeper oceanic waters (NMFS unpublished data). For the aerial and shipboard surveys, sightings were almost exclusively in the continental shelf edge and continental slope water areas. The data were analyzed using DISTANCE (Buckland et al. 1993; Laake et al. 1993) where the CV was estimated using the bootstrap lognormal method. Abundance estimates from the 1991 aerial survey were 612 (CV = 0.73) and 370 (CV = 0.65), respectively, for the AT-11 and Twin Otter. Data were not pooled, because the interplatform calibration analysis has not been conducted. Furthermore, these estimates are not fully comparable to the CeTAP estimates, because the 1991 data are from a single survey, August to October, while the CeTAP estimates were based on data pooled over several years of seasonal surveys.

An abundance estimate from the August 1990 shipboard survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank, was 442 (CV = 0.51). The 1991 survey estimate, based principally on sighting effort conducted between the 200 and 2,000 meter isobaths from Cape Hatteras to Georges Bank was 262 beaked whales (CV = 0.99). The estimate for the 1993 survey, conducted principally between the 200 and 2,000 meter isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southwestern edge of the Scotian Shelf was 330 beaked whales (CV = 0.66). The 1994 estimate, based on survey effort within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank was 99 beaked whales (CV = 0.64). Because the number of beaked whale sightings in each survey were extremely low (3 to 10), and their sightability and behavior preclude pooling with other cetaceans, the estimates of abundance are based on small sample sizes. Therefore, the above abundance estimates should be viewed with caution.

Although the 1990-1994 surveys did not sample exactly the same areas or encompass the entire beaked whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-94 data suggest that, seasonally, at least several hundred beaked whales are occupying these waters, with highest levels of abundance in the Georges Bank region. This is consistent with the earlier CeTAP results. Recent results suggest that beaked whale abundance may be highest in association with Gulf Stream and warm-core ring features. However, at present there are no estimates of total abundance for beaked whales in the western North Atlantic.

Because the estimates presented here were not dive-time corrected, they are likely negatively biased and probably underestimate actual abundance. Given that *Mesoplodon* spp. prefers deep-water habitats (Mead 1989) the bias may be substantial.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate for this stock.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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

No PBR can be estimated for this species at this time, because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Beaked whales (many unidentified as to species) have been killed in the pelagic drift gillnet fishery off the U.S. Atlantic coast. While there are no reported takes in other continental shelf edge fisheries (i.e., pelagic pair trawl, longline), observer coverage in these fisheries is low and because beaked whales occupy this habitat, unreported takes may have occurred.

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic Exclusive Economic Zone (EEZ) might have been subject to the observed fishery-related mortality and serious injury. Twenty-two fishery-related beaked whale mortalities were observed between 1989 and 1993. The 1989-1993 total average estimated annual fishery-related mortality of beaked whales in the U.S. EEZ was 34 (CV = 0.69). Although PBR cannot be determined, the total fishery-related mortality and serious injury for this stock is not considered to be 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.

Fisheries Information

There is no historical information available that documents incidental mortality in either U.S. or Canadian Atlantic coast fisheries (Read 1994).

Current data sources include the Northeast Fisheries Science Center (NEFSC) Weigh Out Data Program and Sea Sampling Observer Program initiated in 1989. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries. These logbooks are maintained at Southeast Fisheries Science Center (SEFSC). 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. Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

By-catch has been observed by NMFS Sea Samplers in the swordfish/tuna/shark drift gillnet fishery, but no mortalities have been documented in the Atlantic swordfish/tuna/shark longline, Atlantic swordfish/tuna/shark pair trawl, New England multispecies sink gillnet, or New England groundfish trawl observed fisheries.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). By-catch of beaked whales has only occurred from Georges Canyon to Hydrographer Canyon along the continental shelf break and continental slope during July to October. Twenty-two fishery-related beaked whale mortalities were observed between 1989 and 1993. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.49), 76 in 1990 (0.56), 13 in 1991 (0.57), 9.7 in 1992 (0.53), and 12 in 1993 (0.32).

STATUS OF STOCK

The status of Sowerby's beaked whale relative to OSP in U.S. Atlantic coast waters is unknown. This species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine population trends and the level of human-caused mortality and serious injury is unknown because of uncertainty regarding species identification in observed fisheries. If one were to assume that the incidental fisheries mortality of the four *Mesoplodon* spp. and *Z. cavirostris* was random with respect to species (i.e., in proportion to their relative abundance), then the minimum population estimate for all of those stocks would need to sum to at least 3,400 in order for an annual mortality of 34 animals not to exceed the PBR of any one of these species. Because an assumption of unselective incidental fishing mortality is probably overly optimistic and represents a best case situation, it is likely that a combined minimum population estimate of substantially greater than 3,400 would be necessary for an annual mortality of 34 to not exceed the PBR of any one of these five stocks. The largest recent abundance estimate available for beaked whales in the western North Atlantic was 612 (CV = 0.73), which would result in a minimum population estimate of 353 beaked whales; however, this estimate does not include a correction factor for submerged animals which may be substantial. This is a strategic stock because of uncertainty regarding stock size and evidence of fishery-related mortality and serious injury.

REFERENCES

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.

Buckland, S. T., D. R. Andersen, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman and Hall, New York, 446 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.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 pp.

Lien J., F. Barry, K. Breeck, and U. Zuschlag. 1990. Status of Sowerby's Beaked Whale, *Mesoplodon bidens*, in Canada. Can. Fld. Nat. 104(1): 125-130.

Mead, J. G. 1989. Beaked whales of the genus *Mesoplodon*. Pages 349-430 *in* S. H. Ridgway and R. Harrison (editors), Handbook of Marine Mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, London.

Nicolas, J., A. Williams, G. Repucci. 1993. Observations of beaked whales (*Mesoplodon* spp.) in the western North Atlantic Ocean. Proceedings of the Tenth Biennial Conference on the Biology of Marine Mammals, Nov. 11-15, 1993, Galveston, TX (Abstract).

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.

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.

RISSO'S DOLPHIN (*Grampus griseus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphin is distributed worldwide in tropical and temperate seas. Risso's dolphins generally have an oceanic range, and occur along the Atlantic coast of North America from Florida to eastern Newfoundland (Leatherwood et al. 1976; Baird and Stacey 1990). Off the northeast U.S. coast, Risso's dolphin is distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank during the spring, summer, and autumn (CeTAP 1982; Payne et al. 1984). In winter, the range begins at the mid-Atlantic bight and extends further into oceanic waters (Payne et al. 1984). In general, the population generally occupies the mid-Atlantic continental shelf edge year round, and is rarely seen in the Gulf of Maine (Payne et al. 1984). During 1990, 1991, and 1993 spring/summer surveys conducted in continental shelf edge and deeper oceanic waters, sightings of Risso's dolphins were associated with strong bathymetric features, Gulf Stream warm-core rings, and the Gulf Stream north wall (Waring et al. 1992; Waring 1993). There is no information on stock differentiation of Risso's dolphin in the western North Atlantic.

POPULATION SIZE

The total number of Risso's dolphins off the eastern U.S. and Canadian Atlantic coast is unknown, although several estimates from selected regions do exist. Seasonal abundance estimates are available from an aerial survey program conducted in continental shelf and continental shelf edge waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982). An estimate based on a weighted (variance) pooling of CeTAP (1982) spring and summer data is 4,980 (CV = 0.34). An average for these two seasons was chosen because the greatest proportion of the population off the northeast U.S. coast appears to be in the CeTAP study area in these seasons. This estimate was not corrected for g(0), the probability of detecting an animal group on the trackline.

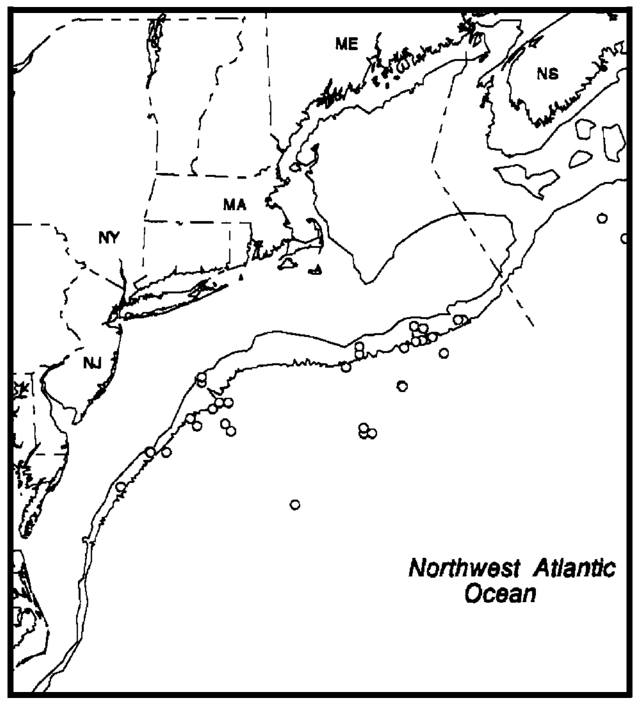


Figure 1. *Distribution of Risso's dolphin sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

Abundance estimates were also derived using data collected during an autumn 1991 aerial survey in the CeTAP study area (NMFS unpublished data), which included an interplatform experiment between a Twin Otter and an AT-11), and from two fine-scale ship surveys (June-July 1991 and June-July 1993) conducted in continental shelf edge and deeper oceanic waters (NMFS unpublished data). For the aerial and shipboard surveys, sightings were almost exclusively in the continental shelf edge and continental slope water areas.

Abundance estimates from the 1991 aerial survey were 16,818 (CV = 0.52) and 6,496 (CV = 0.74), respectively, for the AT-11 and Twin Otter. Data were not pooled, because the areas covered by the two survey platforms were not comparable. Furthermore, these estimates are not fully comparable to the CeTAP estimates, because the 1991 data are from a single survey, August to October, while the CeTAP estimates were based on data pooled over several years of seasonal surveys.

Estimates have been prepared for two of the shipboard surveys in which Risso's dolphins were sighted. An estimate from the 1991 survey, based principally on sighting effort conducted between the 200 and 2,000 meter isobaths from Cape Hatteras to Georges Bank is 5,353 Risso’s dolphins (CV = 0.68). The estimate for the 1993 survey, conducted principally between the 200 and 2,000 meter isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southwestern edge of the Scotian Shelf is 212 Risso’s dolphins (CV = 0.62). The few Risso's dolphin sightings made during August 1990 and 1994 were widely scattered, and therefore were not used to obtain abundance estimates. It should be noted, however, that nearly all of the sightings in these two years were in deeper oceanic waters (Waring 1993; NMFS unpublished data). Although the 1991 and 1993 surveys did not sample exactly the same areas or encompass the entire Risso's dolphin habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective data suggest that at least several thousand Risso's dolphins occupy these waters seasonally; however, survey coverage to date was not judged adequate to provide a definitive estimate of Risso's dolphin abundance in the western North Atlantic.

Present population trends of Risso's dolphins in Canadian waters are unknown due to the scarcity of reported sightings and lack of distribution surveys.

Minimum Population Estimate

The minimum population estimate was based on the AT-11 aerial survey abundance estimate in autumn 1991, of 16,818 Risso’s dolphins (CV = 0.52) (NMFS unpublished data). The AT-11 estimate was selected because that survey provided the most complete coverage of continental shelf edge and continental slope waters off the northeast U.S. coast. The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994), and was 11,140 Risso's dolphins.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

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 0.50 because of the stock's status relative to its OSP level is unknown. PBR for this stock is 111 Risso's dolphins.

ANNUAL HUMAN-CAUSED MORTALITY

Foreign fishery observers documented the incidental take of a small number of Risso's dolphins in foreign squid (three animals) and tuna longline (one animal) fisheries (Waring et al. 1990). Between 1989 and 1993, 36 mortalities were observed in the large pelagic drift gillnet fishery, one mortality in the pelagic pair trawl fishery, and one in the pelagic longline fishery (NMFS unpublished data, see below). No mortalities were documented for the New England multispecies sink gillnet and groundfish trawl fisheries and no takes were documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Total average annual total fishery-related mortality is 68 Risso’s dolphins (CV = 0.53). 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 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.

Fisheries Information

Prior to 1977, there was no documentation of marine mammal by-catch in distant-water fleet (DWF) activities off the northeast coast of the U.S. With implementation of the Magnuson Fisheries Conservation and Management

Act (MFCMA) in that year, an observer program was established which has recorded fishery data and information of incidental by-catch of marine mammals. DWF effort in the U.S. Atlantic Exclusive Economic Zone (EEZ) under MFCMA has been directed primarily towards Atlantic mackerel and squid. From 1977 through 1982, an average of 120 different foreign vessels per year (range 102-161) operated within the U.S. Atlantic EEZ. In 1982, there were 112 different foreign vessels; 16%, or 18, were Japanese tuna longline vessels operating along the U.S. 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 1991, the numbers of foreign vessels operating within U.S. Atlantic EEZ each year were 67, 52, 62, 33, 27, 26, 14, 13, and 9, respectively. Between 1983 and 1988, the numbers of DWF vessels included 3, 5, 7, 6, 8, and 8, respectively, Japanese longline vessels. Observer coverage on DWF vessels was 25-35% during 1977-82, and increased to 58%, 86%, 95%, and 98%, respectively, in 1983-86. From 1987-91, 100% observer coverage was maintained. Foreign fishing operations for squid and mackerel ceased at the end of the 1986 and 1991 fishing seasons, respectively. NMFS foreign-fishery observers have reported four deaths of Risso's dolphins incidental to squid and mackerel fishing activities in the continental shelf and continental slope waters between March 1977 and December 1991 (Waring et al. 1990; NMFS unpublished data). Three animals were taken by squid trawlers and a single animal was killed in longline fishing operations.

Data on incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook 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 provides observer coverage of vessels fishing south of Cape Hatteras.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). Thirty seven Risso's dolphin mortalities were observed between 1989 and 1993. One animal was entangled and released alive. By-catch occurred during July, September and October along continental shelf edge canyons off the southern New England coast. Estimated annual mortality and serious injury (CV in parentheses) attributable to the drift gillnet fishery was 87 in 1989 (0.52), 144 in 1990 (0.46), 21 in 1991 (0.55), 31 in 1992 (0.27), and 14 in 1993 (0.42); average annual mortality and serious injury during 1989-1993 was 59 (0.61).

During the period 1989 to 1993, effort in the Atlantic swordfish/tuna/shark pair trawl fishery has increased, from zero hauls in 1989 and 1990, to an estimated 171 hauls in 1991 and then to an estimated 989 and 1087 hauls in 1992 and 1993 respectively. The fishery operated from August to November in 1991, from June to November in 1992, and from June to October in 1993. Sea sampling began in October of 1992 where 101 sets (10% of the total) were sampled. In 1993, 201 hauls (18% of the total) were sampled. Nineteen vessels have operated in this fishery. The fishery extends from 35ºN to 41ºN, and from 69°W to 72°W. Approximately 50% of the total effort was in a one degree square at 39ºN, 72ºW, around Hudson Canyon. Examination of the locations and species composition of the by-catch, showed little seasonal change for the 6 months of operation and did not warrant any seasonal or areal stratification of this fishery (Northridge, in review). One mortality was observed in 1992. Estimated annual mortality and serious injury (CV in parentheses) to Risso's dolphins in the Atlantic swordfish/tuna/shark pair trawl fishery was 0.6 in 1991 (1.0), 4.3 in 1992 (0.76) and 3.2 in 1993 (1.0); average annual mortality and serious injury during 1991-1993 was 2.7 (0.98).

Pelagic swordfish, tunas, and billfish are the targets of the U.S. longline fishery in the U.S. Atlantic and Gulf of Mexico EEZ (SEFSC unpublished logbook data). Total longline effort for the Atlantic pelagic fishery (including the Caribbean), based on mandatory logbook reporting, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). The fishery has been observed from January to March off Cape Hatteras, in May and June in the entire Mid-Atlantic, and in July through December in the Mid-Atlantic Bight and off Nova Scotia. This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. One Risso's dolphin mortality was observed in 1993, producing an estimated total longline fishery-related mortality of 13 Risso's dolphins (CV = 0.19) for 1993, and a 1992-1993 estimated annual average of 6.5 (CV = 0.27).

STATUS OF STOCK

The status of Risso's dolphins relative to OSP in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. The 1990-93 average annual fishery-related mortality did not exceed PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Baird, R. W. and P. J. Stacey. 1990. Status of Risso's dolphin, *Grampus griseus*, in Canada. Can. Fld. Nat. 105:233-242.

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.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 pp.

Payne, P. M., L. A. Selzer and A. R. Knowlton. 1984. Distribution and density of cetaceans, marine turtles, and seabirds in the shelf waters of the northeastern United States, June 1980-December 1983, based on shipboard observations. NOAA/NMFS Contract No. NA-81-FA-C-00023.

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.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

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., 88:347-360.

Waring, G. T., C. P. Fairfield, C. M. Ruhsam and M. Sano. 1992. Cetaceans associated with Gulf Stream features off the northeastern USA shelf. ICES Marine Mammals Comm. CM 1992/N:12, 29 pp.

Waring, G. T. 1993. Spatial patterns of six cetaceans along a linear habitat. Proceedings of the Tenth Biennial Conference on the Biology of Marine Mammals, Nov. 11-15, 1993, Galveston, TX (Abstract).

LONG-FINNED PILOT WHALE (*Globicephala melas*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of pilot whales in the Western Atlantic — the Atlantic or long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to identify to the species level at sea; therefore, some of the descriptive material below refers to *Globicephala* spp., and is identified as such. The species boundary is considered to be in the New Jersey to Cape Hatteras area. Sightings north of this area are likely *G. melas*.

Pilot whales (*Globicephala* spp.) are distributed principally along the continental shelf edge in the winter and early spring off the northeast U.S. coast, (CeTAP 1982; Payne and Heinemann 1993). In late spring, pilot whales move onto Georges Bank and into the Gulf of Maine and more northern waters, and remain in these areas through late autumn (CeTAP 1982; Payne and Heinemann 1993). In general, pilot whales generally occupy areas of high relief or submerged banks. They are also associated with the Gulf Stream north wall and thermal fronts along the continental shelf edge.

The long-finned pilot whale is distributed from North Carolina to Iceland and possibly the Baltic Sea (Sergeant 1962; Leatherwood et al. 1979; Abend 1993). The stock structure of the North Atlantic population is currently unknown (Anon., 1993); however, several recently initiated genetic studies and proposed North Atlantic sighting surveys will likely provide information required to delineate stock boundaries.

POPULATION SIZE

The total number of long-finned pilot whales off the eastern U.S. and Canadian Atlantic coast is unknown, but several estimates from selected regions do exist. Mitchell (1974) used cumulative catch data from the 1951-61 drive fishery off Newfoundland to estimate the initial population size (ca. 50,000 animals). Mercer (1975), used population models to estimate a population in the same region of between 43,000-96,000 long-finned pilot whales, with a range of 50,000-60,000 being considered the best estimate.

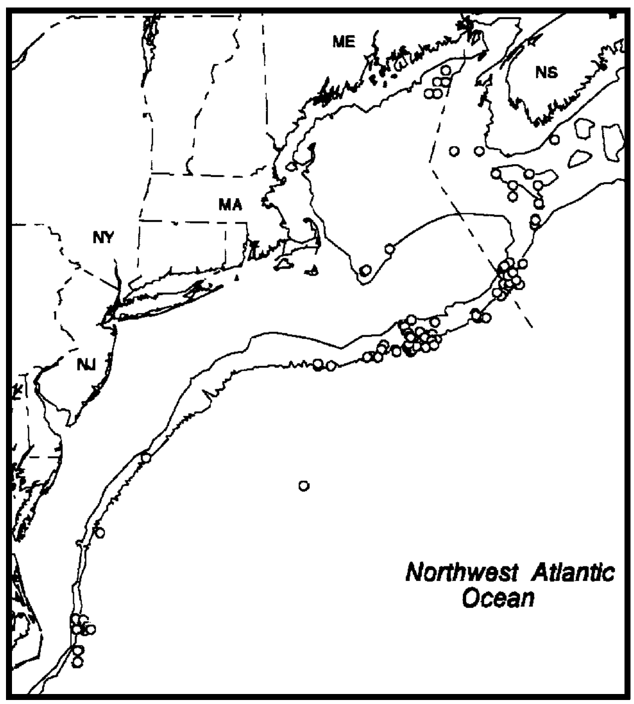


Figure 1. *Distribution of pilot whale sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

Seasonal abundance estimates are available from an aerial survey program conducted in the continental shelf waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982). Because pilot whales are difficult to identify at sea, seasonal abundance estimates were reported at the generic level. An estimate based on variance-weighted pooling of CeTAP (1982) spring, summer, and autumn data is 11,120 long-finned pilot whales (CV = 0.29). An average for these three seasons was chosen because the greatest proportion of the population off the northeast U.S. coast appears to be in the CeTAP study area in these seasons. This estimate was not corrected for g(0), the probability of detecting an animal group on the trackline.

Abundance estimates were also derived using data collected during an autumn 1991 aerial survey in the CeTAP study area (Northeast Fisheries Science Center NMFS unpublished data), which included an interplatform experiment between a Twin Otter and an AT-11), and from three fine-scale ship surveys (August 1990, June-July 1991, and June-July 1993) conducted in continental shelf edge and deeper oceanic waters (NMFS unpublished data). Sightings were made along the continental shelf edge, in the western Gulf of Maine, and on the northwestern edge of Georges Bank during the 1991 aerial survey. Abundance estimates for *Globicephala* spp. were 5,377 (CV = 0.53) and 3,668 (CV = 0.28) for the AT-11 and NOAA Twin Otter , respectively. Data were not pooled, because the interplatform calibration analysis has not been conducted. These estimates are not fully comparable to the CeTAP estimates, because the 1991 data are from a single survey conducted during August-October, while the CeTAP estimates were based on data pooled over several years of seasonal surveys.

The three shipboard surveys covered relatively small portions of the northeastern U.S. Exclusive Economic Zone (EEZ) and pilot whale sightings during these surveys are shown in Figure 1. The abundance estimate from the August 1990 survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank, is 1,043 long-finned pilot whales (CV = 0.78). The 1991 survey estimate, based principally on sighting effort conducted between the 200 and 2,000 meter isobaths from Cape Hatteras to Georges Bank is 896 (CV = 0.68). The estimate for the 1993 survey, conducted principally between the 200 and 2,000 meter isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southwestern edge of the Scotian Shelf is 668 long-finned pilot whales (CV = 0.55).

Although the 1990-1993 surveys did not sample the same areas or encompass the entire pilot whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-93 data suggest that, seasonally, at least several thousand pilot whales are occupying these waters; however, survey coverage to date is not judged adequate to provide a definitive estimate of pilot whale abundance in the western North Atlantic.

Minimum Population Estimate

The minimum population estimate was based on the AT-11 aerial survey abundance estimate in 1991 of 5,377 long-finned pilot whales (CV = 0.53) (NMFS unpublished data). The AT-11 estimate was selected because that survey provided the most complete coverage of continental shelf edge and continental slope waters off the northeast U.S. coast. The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994) and was 3,537 long-finned pilot whales.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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).

Some of the life history parameters which have been estimated from animals taken in the Newfoundland drive fishery include: calving interval 3.3 years; lactation period about 21-22 months; gestation period 12 months; births mainly from June to November. Length at birth is 177 cm; mean length at sexual maturity, 490 cm, males; and 356 cm, females; age at sexual maturity is 12 years for males and 6 years for females, and mean adult length is 557 cm for males and 448 cm for females; and maximum age was 40 for males, and 50 for females (Sergeant 1962; Kasuya et al. 1988). Analysis of data recently collected from animals taken in the Faroe Islands drive fishery produced higher values for all parameters (Bloch et al. 1993; Desportes et al. 1993; Martin and Rothery 1993). These differences are likely related, at least in part, to larger sample sizes and newer analytical techniques.

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 0.40 because of the high variance associated with the estimate of total annual fishery-related mortality and serious injury for *Globicephala* spp. PBR for this stock is 28 long-finned pilot whales.

ANNUAL HUMAN-CAUSED MORTALITY

Pilot whales also have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. Between two and 120 pilot whales have stranded annually either individually or in groups in the NMFS Northeast Region (Anon. 1993) since 1980.

Foreign fishery observers documented 436 pilot whale mortalities in Atlantic mackerel and squid fisheries (Waring et al. 1990; Waring,1995). Between 1989 and 1993, forty two mortalities were observed in the large pelagic drift-gillnet fishery, five in the pelagic pair trawl fishery, and one each in the pelagic longline and groundfish trawl fisheries (NMFS unpublished data; see below). Although only one mortality has been observed in the U.S. large pelagic longline fishery, 24 pilot whales were released alive, two injured, after becoming entangled or hooked in this gear. Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). One mortality was observed in New England groundfish trawl fisheries. There were no takes in the New England multispecies sink gillnet fishery. An unknown number of pilot whales have also been taken in Newfoundland and Labrador, and Bay of Fundy, groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, and Atlantic Canada cod traps (Read 1994).

Total fishery-related mortality and serious injury cannot be estimated separately for the two species of pilot whales in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury. Total estimated annual fishery-related mortality of pilot whales from NMFS-observed fisheries was the sum of integer-rounded annual mortality estimates across the pelagic longline, drift gillnet, and groundfish trawl fisheries and was 109 pilot whales, *Globicephala* spp. (CV = 0.90).

Total fishery-related mortality and serious injury of pilot whales is not less than 10% of the calculated PBR for this stock and, therefore, cannot be considered to be 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.

Fisheries Information

Prior to 1977, there was no documentation of marine mammal by-catch in distant-water fleet (DWF) activities off the northeast coast of the U.S. A fishery observer program, which has collected fishery data and information on incidental by-catch of marine mammals, was established in 1977 with the implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA). DWF effort in the Atlantic coast EEZ under MFCMA has been directed primarily towards Atlantic mackerel and squid. An average of 120 different foreign vessels per year (range 102-161) operated within the Atlantic coast EEZ during 1977 through 1982. In 1982, there were 112 different foreign vessels; 18 (16%) were Japanese tuna longline vessels operating along the U.S. Atlantic coast. This was the first year that the Northeast Regional Observer Program assumed responsibility for observer coverage of the longline vessels. The number of foreign vessels operating within the U.S. Atlantic EEZ each year between 1983 and 1991 averaged 33 and ranged from nine to 67. The number of Japanese longline vessels included among the DWF vessels averaged six and ranged from three to eight between 1983 and 1988. MFCMA observer coverage on DWF vessels was 25-35% during 1977-82, increased to 58%, 86%, 95%, and 98%, respectively, during 1983-86, and 100% observer coverage was maintained from 1987-91. Foreign fishing operations for squid ceased at the end of the 1986 fishing season and, for mackerel, at the end of the 1991 fishing season.

During 1977-1991, observers in this program recorded 436 pilot whale mortalities in foreign-fishing activities (Waring et al. 1990; Waring 1995). A total of 391 (90%) were taken in the mackerel fishery, and 41 (9%) occurred during *Loligo* and *Illex* squid-fishing operations. This total includes 48 documented takes by U.S. vessels involved in joint venture fishing operations in which U.S. captains transfer their catches to foreign processing vessels. Due to temporal fishing restrictions, the by-catch occurred during winter/spring (December to May) in continental shelf and continental shelf edge waters (Fairfield et al. 1993; Waring, 1995); however, the majority of the takes occurred in late spring along the 100 m isobath. Two animals were also caught in both the hake fishery and tuna longline fisheries (Waring et al. 1990).

The Atlantic Canadian and Greenland salmon gillnet fishery is seasonal, with the peak from June to September, depending on location. In southern and eastern Newfoundland, and Labrador during 1989, 2,196 nets 91 m long were used. There are no effort data available for the Greenland fishery; however, the fishery was terminated in 1993 under an agreement between Canada and North Atlantic Salmon Fund (Read 1994).

The groundfish gillnet fishery is widespread and important. Many fisherman hold groundfish gillnet licenses but the number of active fishermen is unknown. In 1989, approximately 6,800 licenses were issued to fishermen along the southern coast of Labrador, and northeast and southern coast of Newfoundland. In the Gulf of St. Lawrence, there were about 3,900 licenses issued in 1989, while in the Bay of Fundy and southwestern Nova Scotia 659 licenses were issued.

There were 3,121 cod traps operating in Newfoundland and Labrador during 1979, and about 7,500 in 1980 (Read 1994). This fishery was closed at the end of 1993 due to collapse of Canadian groundfish resources.

The distribution of long-finned pilot whale, a northern species, overlaps with that of the short-finned pilot whale, a predominantly southern species, between 35°30'N to 38°00'N (Leatherwood et al. 1976). Although long-finned pilot whales are most likely taken in the waters north of Delaware Bay, many of the pilot whale takes are not identified to species and by-catch does occur in the overlap area. In this summary, therefore, long-finned pilot whales (*Globicephala melas*) and unidentified pilot whales (*Globicephala* spp.) are considered together.

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook 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 provides observer coverage of vessels fishing south of Cape Hatteras.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). Forty-two pilot whale (*Globicephala* spp.) mortalities were observed between 1989 and 1993. Six animals were released alive but one was injured. The annual fishery-related mortality (CV in parentheses) was 77 in 1989 (1.1), 132 in 1990 (0.59), 30 in 1991 (0.76), 33 in 1992 (0.29), and 31 in 1993 (0.34); average annual mortality between 1989-1993 was 61 pilot whales (0.87). Because animals released alive may have subsequently died due to injuries received during entanglement, pilot whales that were released were included in the mortality estimates. Pilot whales were taken along the continental shelf edge, northeast of Cape Hatteras in January and February. Takes were recorded at the continental shelf edge east of Cape Charles, Virginia, in June. Pilot whales were taken from Hydrographer Canyon along the Great South Channel to Georges Bank from July-November. Takes occurred at the Oceanographer Canyon continental shelf break and along the continental shelf northeast of Cape Hatteras in October-November.

Effort in the Atlantic swordfish/tuna/shark pair trawl fishery has increased during the period 1989 to 1993, from zero hauls in 1989 and 1990, to an estimated 171 hauls in 1991, and then to an estimated 989 and 1087 hauls in 1992 and 1993, respectively. The fishery operated from August-November in 1991, from June-November in 1992, and from June-October in 1993. Sea sampling began in October 1992, and 101 sets (10% of the total) were sampled in that season, 201 hauls (18% of the total) were sampled in 1993. Nineteen vessels have operated in this fishery. The fishery extends from 35ºN to 41ºN, and from 69°W to 72°W. Approximately 50% of the total effort was within a one degree square at 39ºN, 72ºW, around Hudson Canyon. Examination of the locations and species composition of the by-catch, showed little seasonal change for the six months of operation and did not warrant any seasonal or areal stratification of this fishery (Northridge, in review). Five pilot whale (*Globicephala* spp.) mortalities were reported from logbook entries in 1993, but no fishery-related mortality or serious injury was reported by observers.

Pelagic swordfish, tunas, and billfish are the targets of the U.S. longline fishery in the U.S. Atlantic and Gulf of Mexico EEZ (SEFSC unpublished logbook data). Interactions between the longline swordfish/tuna fishery and pilot whales have been reported; however, a vessel may fish in more than one statistical reporting area and it is not possible to separate estimates of fishing effort other than to subtract Gulf of Mexico effort from Atlantic fishing effort, which includes the Caribbean Sea. This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. Total longline effort for the Atlantic pelagic fishery (including the Caribbean), based on mandatory logbook reporting, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). The fishery has been observed from January to March off Cape Hatteras, in May and June in the entire Mid-Atlantic, and in July through December in the Mid-Atlantic Bight and off Nova Scotia. Twenty four animals were released alive, but two were injured. One mortality was observed between 1990 and 1993. January-March by-catch was concentrated on the continental shelf edge northeast of Cape Hatteras. By-catch was recorded in this area during April-June, and takes also occurred north of Hydrographer Canyon off the continental shelf in water over 1,000 fathoms during April-June. During the July-September period, takes occurred on the continental shelf edge east of Cape Charles, Virginia, and on Block Canyon slope in over 1,000 fathoms of water. October-December by-catch occurred along the 20 to 50 fathom contour lines between Barnegatt Bay and Cape Hatteras. Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery (SEFSC unpublished data). The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery occurred in 1992 and was 22 (CV = 0.23); average annual mortality between 1992-1993 was eleven pilot whales (0.33).

Vessels in the New England groundfish multispecies trawl fishery, a Category III fishery under the MMPA, were observed in order to meet fishery management needs, rather than marine mammal management needs. An average of 970 (CV = 0.04) vessels (full and part time) participated annually in the fishery during 1989-1993. The fishery is active in New England in all seasons. One mortality was documented between 1989 and 1993. Also, one animal was released alive. The estimated fishery-related mortality in 1990 was 184 (CV = 0.99); average annual fishery-related mortality during 1989-1993 was 37 pilot whales (2.21).

The mid-Atlantic mackerel and squid trawl fisheries were combined into the Atlantic mid-water trawl fishery in the revised proposed list of fisheries in 1995. The fishery occurs along the U.S. mid-Atlantic continental shelf region between New Brunswick, Canada, and Cape Hatteras year around. The mackerel trawl fishery was classified as a Category II fishery since 1990 and the squid fishery was originally classified as a Category II fishery in 1990, but was reclassified as a Category III fishery in 1992. The combined fishery has been proposed for classification as a Category II fishery. Three fishery-related mortality of pilot whales were reported in logbook reports from the mackerel trawl fishery between 1990-1992.

Other Mortality

A potential human-caused source of mortality is from polychlorinated biphenyls (PCBs) and DDT, moderate levels of which have been found in pilot whale blubber (Taruski 1975; Muir et al. 1988). The effect of the observed levels of such contaminants is unknown.

STATUS OF STOCK

The status of long-finned pilot whales relative to OSP in U.S. Atlantic coast waters is unknown, but stock abundance may have been affected by reduction in foreign fishing, curtailment of the Newfoundland drive fishery for pilot whales in 1971, and increased abundance of herring, mackerel, and squid stocks. There are insufficient data to determine the population trends for this species. The species is not listed under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. The total level of human-caused mortality and serious injury is believed to be significant based on current data. This is a strategic stock because the 1989-93 estimated average annual fishery-related mortality to pilot whales, *Globicephala* spp., exceeds PBR.

REFERENCES

Abend, A. 1993. Long-finned pilot whale distribution and diet as determined from stable carbon and nitrogen ratio isotope tracers. M.S. Thesis, University of Massachusetts, Amherst.

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.

Anon. 1993. Status of fishery resources off the northeastern United States for 1993. NOAA Tech. Mem. NMFS-F/NEC-101, 140 pp.

Bloch, D., M. Zachariassen and P. Zachariassen. 1993. Some external characters of the long-finned pilot whale off Faroe Island and a comparison with the short-finned pilot whale. Rep. Int. Whal. Commn. Special Issue 14:117-135.

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.

Desportes, G., M. Saboureau and A. Lacroix. 1993. Reproductive maturity and seasonality of male pilot long-finned whales off the Faroe Islands. Rep. Int. Whal. Commn. Special Issue 14: 233-262.

Fairfield, C. P., G. T. Waring and M. H. Sano. 1993. Pilot whales incidentally taken during the distant water fleet Atlantic mackerel fishery in the mid-Atlantic Bight, 1984-88. Rep. Int. Whal. Commn. Special Issue 14: 107-116.

Kasuya, T., D. E. Sergeant and K. Tanaka. 1988. Re-examination of life history parameters of long-finned pilot whales in the Newfoundland waters. Sci. Rep. Whales Res. Inst. No. 39: 103-119.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 pp.

Martin, A. R. and P. Rothery. 1993. Reproductive parameters of female long-finned pilot whales (*Globicephala melas*) around the Faroe Islands. Rep. Int. Whal. Commn. Special Issue 14: 263-304.

Mercer, M. C. 1975. Modified Leslie-DeLury population models of the long-finned pilot whale (*Globicephala melaena*) and annual production of the short-finned squid (*Illex illecebrosus*) based upon their interactions at Newfoundland. J. Fish. Res. Bd. Can. 32(7): 1145-54.

Mitchell, E. 1975. Present status of northwest Atlantic fin and other whale stocks. Pages 108-169 *in* W. E. Schevill (editor), The whale problem: A status report. Harvard University Press, Cambridge, Massachusetts, 419 pp.

Muir, D. C. G., R. Wagermann, N. P. Grift, R. J. Norstrom, M. Simon, and J. Lien. 1988. Organochlorine chemical and heavy metal contaminants in white-beaked dolphins (*Lagenorhynchus albirostris*) and pilot whales (*Globicephala melaena*) from the coast of Newfoundland. Canada. Arch. Environ. Contam. Toxicol. 17: 613-29.

Payne, P. M. and D. W. Heinemann. 1993. The distribution of pilot whales (*Globicephala* spp.) in shelf/shelf edge and slope waters of the northeastern United States, 1978-1988. Rep. Int. Whal. Commn. Special Issue 14: 51-68.

Sergeant D. E. 1962. The biology of the pilot or pothead whale (*Globicephala melaena* (Traill) in Newfoundland waters. Bull. Fish. Res. Bd. Can. 132: 1-84.

Taruski, A. G., C. E. Olney, and H. E. Winn. 1975. Chlorinated hydrocarbons in cetaceans. J. Fish. Res. Bd. Can. 32(11): 2205-9.

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.

Waring, G. T. 1995. Fishery and ecological interactions for selected cetaceans off the northeast USA. Ph.D. dissertation, University of Massachusetts, Amherst, 260 pp.

SHORT-FINNED PILOT WHALE (*Globicephala macrorhynchus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of pilot whales in the Western Atlantic: the Atlantic or long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to identify to the species level at sea; therefore, some of the descriptive material below refers to *Globicephala* spp. and is identified as such. The species boundary is considered to be in the New Jersey to Cape Hatteras area. Sightings north of this area are likely *G. melas*.

The short-finned pilot whale is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983). The northern extent of the range of this species within the U.S. Atlantic Exclusive Economic Zone (EEZ) is generally thought to be Cape Hatteras, North Carolina (Leatherwood and Reeves 1983). Sightings of these animals in U.S. Atlantic EEZ occur primarily within the Gulf Stream [Southeast Fisheries Science Center (SEFSC) unpublished data], and primarily along the continental shelf and continental slope in the northern Gulf of Mexico (Mullin et al. 1991; SEFSC unpublished data). There is no information on stock differentiation for the Atlantic population.

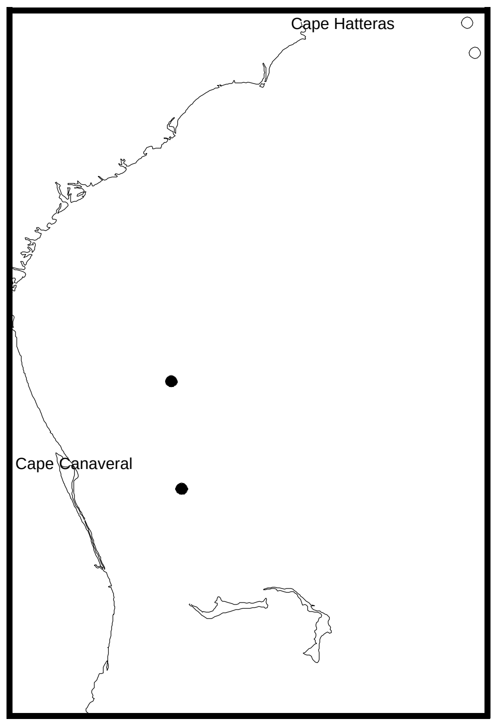


Figure 1. *Sightings of short-finned pilot whales (filled circles) and unidentified pilot whales (unfilled circles) during NOAA Ship Oregon II marine mammal survey cruise in winter 1992.*

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during a 1992 winter, visual sampling, line-transect vessel survey of the U.S. Atlantic EEZ waters between Miami, Florida, and Cape Hatteras, North Carolina. The estimated abundance of short-finned pilot whales for the 1992 survey was 749 (coefficient of variation, CV = 0.64) (Hansen et al. 1994).

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, which is equivalent to the 20th percentile of the log-normal distributed average abundance estimate (Hansen et al. 1994) as specified by NMFS (Anon. 1994). The minimum population estimate was based on the 1992 survey abundance estimate of 749 short-finned pilot whales (CV = 0.64) (Hansen et al. 1994) and was 457.

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 not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.40 because of the high variance associated with the estimate of total annual fishery-related mortality and serious injury for *Globicephala* spp. PBR for this stock is 3.7 short-finned pilot whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of short-finned pilot whales in the U.S. Atlantic EEZ is unknown. The short-finned pilot whale has been taken in the U.S. longline swordfish/tuna fishery in Atlantic waters off the southeastern U.S. (Lee et al. 1994; SEFSC unpublished data). Pilot whales have been taken in fisheries operating in the deeper, offshore waters off the northeastern U.S. waters north of the presumed range of this stock. The pilot whales taken in these fisheries may have been the long-finned pilot whale, *G. melas* (Waring 1990); however, total fishery-related mortality and serious injury cannot be estimated separately for the two species of pilot whales because of the uncertainty in species identification by fishery observers.

There were 101 short-finned pilot whale strandings documented during 1987-1993 along the U.S. Atlantic coast between Cape Hatteras, North Carolina, and Miami, Florida; two of these were classified as likely caused by fishery interactions.

Total fishery-related mortality and serious injury cannot be estimated separately for the two species of pilot whales in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury. Total estimated annual fishery-related mortality of pilot whales from NMFS-observed fisheries was the sum of the integer-rounded annual mortality estimates across the pelagic longline, drift gillnet, and groundfish trawl fisheries and was 109 pilot whales, *Globicephala* spp. (CV = 0.90).

Total fishery-related mortality and serious injury of pilot whales is not less than 10% of the calculated PBR for this stock and, therefore, cannot be considered to be 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.

Fisheries Information

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook 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 provides observer coverage of vessels fishing south of Cape Hatteras.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). Forty-two pilot whale (*Globicephala* spp.) mortalities were observed between 1989 and 1993. Six animals were released alive but one was injured. The annual fishery-related mortality (CV in parentheses) was 77 in 1989 (1.1), 132 in 1990 (0.59), 30 in 1991 (0.76), 33 in 1992 (0.29), and 31 in 1993 (0.34); average annual mortality between 1989-1993 was 61 pilot whales (0.87). Because animals released alive may have subsequently died due to injuries received during entanglement, pilot whales that were released were included in the mortality estimates. Pilot whales were taken along the continental shelf edge, northeast of Cape Hatteras in January and February. Takes were recorded at the continental shelf edge east of Cape Charles, Virginia, in June. Pilot whales were taken from Hydrographer Canyon along the Great South Channel to Georges Bank from July-

November. Takes occurred at the Oceanographer Canyon continental shelf break and along the continental shelf northeast of Cape Hatteras in October-November.

Pelagic swordfish, tunas, and billfish are the targets of the U.S. longline fishery in the U.S. Atlantic and Gulf of Mexico EEZ (SEFSC unpublished logbook data). Interactions between the longline swordfish/tuna fishery and pilot whales have been reported; however, a vessel may fish in more than one statistical reporting area and it is not possible to separate estimates of fishing effort other than to subtract Gulf of Mexico effort from Atlantic fishing effort, which includes the Caribbean Sea. This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. Total longline effort for the Atlantic pelagic fishery (including the Caribbean), based on mandatory logbook reporting, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). The fishery has been observed from January to March off Cape Hatteras, in May and June in the entire Mid-Atlantic, and in July through December in the Mid-Atlantic Bight and off Nova Scotia. Twenty four animals were released alive, but two were injured. One mortality was observed between 1990 and 1993.   January-March by-catch was concentrated on the continental shelf edge northeast of Cape Hatteras. By-catch was recorded in this area during April-June, and takes also occurred north of Hydrographer Canyon off the continental shelf in water over 1,000 fathoms during April-June. During the July-September period, takes occurred on the continental shelf edge east of Cape Charles, Virginia, and on Block Canyon slope in over 1,000 fathoms of water. October-December by-catch occurred along the 20 to 50 fathom contour lines between Barnegatt Bay and Cape Hatteras. Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery (SEFSC unpublished data).   The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery occurred in 1992 and was 22 (CV = 0.23); average annual mortality between 1992-1993 was eleven pilot whales (0.33).

Vessels in the New England groundfish multispecies trawl fishery, a Category III fishery under the MMPA, were observed in order to meet fishery management needs, rather than marine mammal management needs. An average of 970 (CV = 0.04) vessels (full and part time) participated annually in the fishery during 1989-1993. The fishery is active in New England in all seasons. One mortality was documented between 1989 and 1993. Also, one animal was released alive. The estimated fishery-related mortality in 1990 was 184 (CV = 0.99); average annual fishery-related mortality during 1989-1993 was 37 pilot whales (2.21).

The mid-Atlantic mackerel and squid trawl fisheries were combined into the Atlantic mid-water trawl fishery in the revised proposed list of fisheries in 1995. The fishery occurs along the U.S. mid-Atlantic continental shelf region between New Brunswick, Canada, and Cape Hatteras year around. The mackerel trawl fishery was classified as a Category II fishery since 1990 and the squid fishery was originally classified as a Category II fishery in 1990, but was reclassified as a Category III fishery in 1992. The combined fishery has been proposed for classification as a Category II fishery. Three fishery-related mortality of pilot whales were reported in logbook reports from the mackerel trawl fishery between 1990-1992.

STATUS OF STOCK

The status of the short-finned pilot whale relative to OSP in U.S. Atlantic coast waters is unknown. There are insufficient data to determine the population trends for this stock. They are not listed under the Endangered Species Act. This is a strategic stock because the 1989-93 estimated average annual fishery-related mortality to pilot whales, *Globicephala* spp., exceeds PBR for this stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1994. Preliminary estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys, and of selected cetacean species in the U.S. Atlantic Exclusive Economic Zone from vessel surveys from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-93/94-58.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Lee, D. W., C. J. Brown, A. J. Catalano, J. R. Grubich, T. W. Greig, R. J. Miller and M. T. Judge. 1994. SEFSC pelagic longline observer program data summary for 1992-1993. NOAA Tech. Mem. NMFS-SEFSC-347. 19 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana, 108 pp.

WHITE-SIDED DOLPHIN (*Lagenorhynchus acutus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

White-sided dolphins are found in temperate and sub-polar waters of the North Atlantic, primarily on continental shelf waters to the 100 m depth contour. The species occurs from central west Greenland to the Chesapeake Bay (about 37°N) and perhaps as far east as 55º W (Evans 1987). There is no information concerning stock structure within this range.

White-sided dolphins are most common in continental shelf waters from Hudson Canyon (approximately 39°N) north through Georges Bank, in the Gulf of Maine to the lower Bay of Fundy. Low numbers of white-sided dolphins occur from Chesapeake Bay to Jeffreys Ledge (off New Hampshire) during winter and early spring (January to April). From May through June, large aggregations are found from Georges Bank to the southwest Gulf of Maine, while some animals have been seen from the southern Grand Banks, along Newfoundland and into the Labrador Sea. From July to December, the distribution of sightings extends from Georges Bank to the lower Bay of Fundy (Payne and Heinemann 1990) and along Nova Scotia all the way along the coasts to the Labrador Sea and west Greenland (Gaskin 1992).

Before the 1960's, white-sided dolphins in U.S. waters were usually found offshore on the continental slope. There has been an apparent increase in the number of white-sided dolphins seen on the continental shelf from the 1960's to the present. This shift may be due to an increase in sand lance in continental shelf waters of the Gulf of Maine (Katona et al. 1993). With declining sand lance abundance (NMFS unpublished data), occurrence of white-sided dolphins in continental shelf waters may similarly decrease.

POPULATION SIZE

The total number of white-sided dolphins along the eastern U.S. and Canadian Atlantic coast is unknown, although two estimates from select regions do exist. Seasonal abundance estimates are available from an aerial survey line transect program conducted in continental shelf and continental shelf edge waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982), just after the cessation of extensive foreign fishing operations in this region. A population estimate based on an inverse variance weighted pooling of CeTAP spring, summer, and autumn data is 28,600 [coefficient of variation (CV) = 0.21]. An average for these three seasons was chosen because the greatest proportion of the population off the northeast U.S. coast appears to be in the CeTAP study area during these seasons. This estimate was not corrected for g(0), the probability of detecting an animal group on the trackline.

Shipboard line transect surveys in 1991, 1992, and 1993 have provided more recent abundance estimates and white-sided dolphin sightings during these surveys are shown in Figure 1. A weighted-average abundance for the northern Gulf of Maine/lower Bay of Fundy region during the summers of 1991 and 1992 is 20,400 (CV = 0.63), where each annual estimate is weighted by the inverse of its variance (NMFS unpublished data). Two independent teams on the same ship surveyed using the naked eye in non-closing mode. This estimate includes an

Figure 1. *Distribution of white-sided dolphin sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

estimate of g(0) for both teams of 0.62 (CV = 0.90). (The average g(0) for each team separately is 0.35 (CV = 0.46)). In addition, the estimate takes in account of size bias (bias caused by large groups of dolphins being detected with higher probability than small groups). The g(0)-corrected abundance estimate was calculated using the product interval analytical method (Palka, in press) with size-biased corrected estimates of density for the two separate teams. The size-biased density estimates were derived using the computer program DISTANCE version 2.0 (Buckland et al. 1993; Laake et al. 1993). The variance was estimated by bootstrapping the size-biased team density estimates.

The data used were obtained from two shipboard line transect sighting surveys designed to estimate abundance of harbor porpoises (Palka, in press). The study area was stratified by water depth and expected density of harbor porpoises. This stratification scheme could cause uncertainties in a white-sided dolphin abundance estimate because white-sided dolphin habitat in the north-central Gulf of Maine was surveyed at a low intensity. White-sided dolphin abundance was estimated under the reasonable assumption that observed densities of white-sided dolphins in the surveyed offshore waters were similar to densities in the unsurveyed offshore waters.

An abundance estimate was also derived using data collected during a June-July 1993 fine-scale ship survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southwestern edge of the Scotian Shelf (NMFS unpublished data). The survey was conducted by one team searching through high-powered binoculars. The data were analyzed using DISTANCE (Buckland et al. 1993; Laake et al. 1993), where the confidence was estimated using the bootstrap log normal method, and group-size bias was considered. The abundance estimate for white-sided dolphins in this limited portion of their range was 729 (CV = 0.47).

There are no published abundance estimates for this species in Canadian waters which lie farther north or east of the above surveys (Gaskin 1992).

Minimum Population Estimate

The minimum population estimate was based on the 1991-92 shipboard survey abundance estimate of 20,400 white-sided dolphins (CV = 0.63) (NMFS unpublished data). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994), and was 12,538 white-sided dolphins.

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 not known for this stock. Some of the life history parameters which have been estimated include: calving interval is 2-3 years; lactation period is 18 months; gestation period is 10-12 months and births occur from May to early August, mainly in June and July. Length at birth is 110 cm, length at sexual maturity is 230-240 cm for males, and 201-222 cm for females, age at sexual maturity is 8-9 years for males and 6-8 years for females, and the mean adult length is 250 cm for males and 224 cm for females (Evans 1987). Maximum reported age for males is 22 years and for females, 27 years (Sergeant et al. 1980).

The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

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 0.50 because of the stock's status relative to its OSP level is unknown. PBR for this stock is 125 white-sided dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Incidental takes of white-sided dolphins have been recorded in the Gulf of Maine and Bay of Fundy groundfish gillnet fisheries (Gilbert and Wynne 1987; Gaskin 1992). In the mid 1980's, during a University of Maine study, gillnet fishermen retained six carcasses for biological studies. NMFS foreign fishery observers have reported 44 takes of Atlantic white-sided dolphins incidental to fishing activities in the continental shelf and continental slope waters between March 1977 and December 1991 (Waring et al. 1990; NMFS unpublished data). Of these animals, 96% were taken in the Atlantic mackerel fishery. This total includes nine documented takes by U.S. vessels involved in joint-venture fishing operations in which U.S. captains transfer their catches to foreign processing vessels. Recently, white-sided dolphins have been caught in the pelagic drift gillnet fishery, and the New England trawl and sink gillnet fisheries. No mortalities were documented in the Atlantic swordfish/tuna/shark longline and Atlantic swordfish/tuna/shark pair trawl fisheries.

There is little information available which quantifies fishery interactions involving white-sided dolphins in Canadian waters. Two white-sided dolphins were reported caught in groundfish gillnets set in the Bay of Fundy during 1985 to 1989, and nine were taken in West Greenland between 1964 and 1966 in salmon drift nets (Gaskin 1992). Several (number not specified) were also taken in Newfoundland and Labrador groundfish gillnets in the 1960's. A few were taken in an experimental drift gillnet fishery for salmon off West Greenland which took place from 1965 to 1982 (Read 1994). More recent information on Canadian white-sided dolphin takes were not available.

Estimated average annual fishery-related mortality and serious injury to the western North Atlantic white-sided dolphin stock during 1989-1993 was 127 dolphins (CV = 0.52). 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 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.

Fisheries Information

Prior to 1977, there was no documentation of marine mammal by-catch in distant-water fleet (DWF) activities off the northeast coast of the U.S. With implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA) in that year, an observer program was established which has recorded fishery data and information of incidental by-catch of marine mammals. DWF effort in the U.S. Atlantic Exclusive Economic Zone (EEZ) under MFCMA has been directed primarily towards Atlantic mackerel and squid. From 1977 through 1982, an average of 120 different foreign vessels per year (range 102-161) operated within the Atlantic coast EEZ. In 1982, there were 112 different foreign vessels; 16%, or 18, were Japanese tuna longline vessels operating along the U.S. 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 1991, the numbers of foreign vessels operating within the Atlantic coast EEZ each year were 67, 52, 62, 33, 27, 26, 14, 13, and 9, respectively. Between 1983 and 1988, the numbers of DWF vessels included 3, 5, 7, 6, 8, and 8, respectively, Japanese longline vessels. Observer coverage on DWF vessels was 25-35% during 1977-82, and increased to 58%, 86%, 95%, and 98%, respectively, in 1983-86; 100% observer coverage was maintained during 1987-91. Foreign fishing operations for squid ceased at the end of the 1986 fishing season and for mackerel at the end of the 1991 season.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 4.4 in 1989 (1.80), 6.8 in 1990 (1.50), 0.9 in 1991 (2.00), 0.8 in 1992 (1.30), and 2.7 in 1993 (0.32); estimated average annual mortality and serious injury during related to this fishery during 1989-1993 was 3.1 white-sided dolphins (1.88).

Vessels in the New England groundfish multispecies trawl fishery, a Category III fishery under the MMPA, were observed in order to meet fishery management needs, rather than marine mammal management needs. An average of 970 (CV = 0.04) vessels (full and part time) participated annually in the fishery during 1989-1993. The fishery is active in New England in all seasons. One mortality was documented between 1989 and 1993. The estimated fishery-related mortality in 1992 was 110 (CV = 1.00) and average annual estimate fishery-related mortality during 1989-1993 was 22 white-sided dolphins (CV = 2.24).

The mid-Atlantic mackerel and squid trawl fisheries were combined into the Atlantic mid-water trawl fishery in the revised proposed list of fisheries in 1995. The fishery occurs along the U.S. mid-Atlantic continental shelf region between New Brunswick, Canada, and Cape Hatteras year around. The mackerel trawl fishery was classified as a Category II fishery since 1990 and the squid fishery was originally classified as a Category II fishery in 1990, but was reclassified as a Category III fishery in 1992. The combined fishery has been proposed for classification as a Category II fishery. One fishery-related mortality of a white-sided dolphin was reported in logbook reports from the mackerel trawl fishery between 1990-1992.

There are approximately 349 vessels (full and part time) in the New England multispecies sink gillnet fishery (Walden, in review). Observer coverage in trips has been 1%, 6%, 7.5%, and 5% for years 1990 to 1993. The fishery has been observed in the Gulf of Maine and in Southern New England. There have been 73 mortalities observed in this fishery between 1990 and 1993. One animal was released alive and not injured. Estimated annual fishery-related mortalities (CV in parentheses) were 49 in 1991 (0.46), 154 in 1992 (0.35), and 205 in 1993 (0.31); average annual estimated fishery-related mortality during 1991-1993 was 102 white-sided dolphins (0.42). In January to March, the by-catch occurred in Massachusetts Bay, south of Cape Ann and west of Stellwagen Bank. From April to June, by-catch locations became more dispersed, from Casco Bay to Cape Ann, along the 30 fathom contour out to Jeffreys Ledge, with one take location near Cultivator Shoal and one in southern New England near Block Island. In July through September, incidental takes occurred from Frenchman's Bay to Massachusetts Bay. In inshore waters, the takes were aggregated while offshore takes were more dispersed. In October through December, takes were confined from Cape Elizabeth out to Jeffreys Ledge and south to Nantucket Sound.

Other Mortality

Polychlorinated biphenyls (PCBs) and DDT, which have been found in moderate levels in the blubber (Gaskin 1985) are potential sources of human-caused mortality; however, the effect of the observed levels of pollutants is not known.

Mass strandings involving up to a hundred or more animals at one time are common for this species. From 1968 to 1993, 348 Atlantic white-sided dolphins are known to have stranded on the New England coast (Hain and Waring, in preparation). The causes of these strandings are not known. Because such strandings have been known since antiquity, it could be presumed that recent strandings are a normal condition (Gaskin 1992). It is unknown whether human causes, such as fishery interactions and pollution, have increased the number of strandings. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

STATUS OF STOCK

The status of white-sided dolphins relative to OSP in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. This is a strategic stock because average annual fishery-related mortality exceeds PBR.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance Sampling: Estimating abundance of biological populations. Chapman & Hall, New York, 446 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, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

Evans, P. G. H. 1987. The natural history of whales and dolphins. Facts on File Publications, New York, 343 pp.

Gaskin, D. E. 1985. The ecology of whales and dolphins. Heinemann Educational Books: London. 459 pp.

Gaskin, D. E. 1992. Status of Atlantic white-sided dolphin, *Lagenorhynchus acutus*, in Canada. Can. Fld. Nat. 106: 64-72.

Gilbert, J. R. and K. M. Wynne. 1987. Marine mammal interactions with New England gillnet fisheries. Final Report, Contract No. NA-84-EAC-00070, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, Massachusetts, 12 pp.

Hain, J. H. W. and G. T. Waring. In preparation. Marine mammals in New England shelf waters. *In* R. W. Langton and J. B. Pearce (editors), Selected living resources, habitat conditions, and human perturbations of the Gulf of Maine: Environmental and ecological considerations for fishery managements. NOAA Tech. Mem., Northeast Fisheries Science Center, Woods Hole, Massachusetts.

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, DC, 316 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Palka, D. In press. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. Int. Whal. Commn. Special Issue 16.

Payne, M. and D. W. Heinemann. 1990. A distributional assessment of cetaceans in the shelf and shelf edge waters of the northeastern United States based on aerial and shipboard surveys, 1978-1988. Report to National Marine Fisheries Science Center, Woods Hole, Massachusetts.

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.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

Sergeant, D. E., D. J. St. Aubin, and J. R. Geraci. 1980. Life history and northwest Atlantic status of the Atlantic white-sided dolphin, *Lagenorhynchus acutus*. Cetology No. 37: 1-12.

Walden, J. In review. Results of the Gulf of Maine gillnet survey 1989-92. NOAA, NMFS, NEFSC [Northeast Fisheries Science Center] Ref. Doc., Woods Hole, Massachusetts.

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.

WHITE-BEAKED DOLPHIN (*Lagenorhynchus albirostris*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

White-beaked dolphins are the more northerly of the two species of *Lagenorhynchus* in the Northwest Atlantic (Leatherwood et al. 1976). The species is found from southern New England, north to western and southern Greenland and Davis Straits (Leatherwood et al. 1976, CeTAP 1982). Stock structure is unknown.

In waters off the northeastern U.S. coast, white-beaked dolphin sightings have been concentrated in the western Gulf of Maine and around Cape Cod (CeTAP 1982). The limited distribution of this northern species in U.S. waters has been attributed to opportunistic feeding (CeTAP 1982); however, white-beaked dolphins may have been more common in the Gulf of Maine before the 1960s. It has been hypothesized to have exchanged habitat with white-sided dolphins, which were once more common offshore (Katona et al. 1993).

POPULATION SIZE

The total number of white-beaked dolphins in U.S. and Canadian Atlantic waters is unknown. Seasonal abundance estimates are available from an aerial line transect survey program conducted in the continental shelf and continental shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia from 1978 to 1982 (CeTAP 1982). A population estimate of 573 white-beaked dolphins [coefficient of variation (CV) = 0.69] in waters off Cape Cod was based on CeTAP (1982) spring sightings. White-beaked dolphins were not encountered during an August-October 1991 aerial survey in the CeTAP study area, nor were white-beaked dolphins sighted during several fine-scale ship-based surveys conducted in August 1990, June-July 1991,August-September 1991, June-July 1993, August-September 1993, and August 1994, conducted in the Gulf of Maine and over U.S. Atlantic continental shelf edge and deeper oceanic waters (NMFS unpublished data).

A population estimate for Canadian waters of 5,500 white-beaked dolphins was based on a aerial survey off eastern Newfoundland and southeastern Labrador (Alling and Whitehead 1987). A ship-based survey of a small segment of the Labrador Shelf in August 1982 provided an estimate of 3,486 white-beaked dolphins [95% confidence interval (CI) = 2,001-4,971] (Alling and Whitehead 1987). A CV was not given, but, assuming a symmetric CI, it would be 0.22.

There are no abundance estimates for this species in waters between the Gulf of Maine and the Newfoundland/Labrador region.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate in U.S. Exclusive Economic Zone (EEZ) waters.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

POTENTIAL BIOLOGICAL REMOVAL

No PBR can be estimated for this species at this time, because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

White-beaked dolphins have been killed in the Canadian groundfish gillnet fisheries off Newfoundland and Labrador and in the Gulf of St. Lawrence (Alling and Whitehead 1987; Read, in press); however, the total number of animals killed is not known.

There are no documented reports of fishery-related mortality or serious injury to this stock in the U.S. EEZ; therefore, total fishery-related mortality and serious injury for this stock is 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.

Fisheries Information

Because of the absence of observed fishery-related mortality and serious injury to this stock in the U.S. EEZ, no U.S. fishery information is provided.

The Canadian Atlantic groundfish gillnet fishery is important and widespread. Many fisherman hold groundfish gillnet licenses but the number of active fishermen is unknown. In 1989, approximately 6,800 licenses were issued to fishermen along the southern coast of Labrador, and northeast and southern coast of Newfoundland. About 3,900 licenses were issued in 1989 in the Gulf of St. Lawrence and 659 licenses were issued in the Bay of Fundy and southwestern Nova Scotia.

Other Mortality

White-beaked dolphins were, and still may be, hunted for food by residents in northern and southern Labrador (Alling and Whitehead 1987). These authors, based on interview data, estimated that 366 white-beaked dolphins were killed each year.

STATUS OF STOCK

The status of white-beaked dolphins, relative to OSP, in U.S. Atlantic coast waters is unknown. They are not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. This stock has a marginal occurrence in U.S. waters; therefore, this stock is not a strategic stock.

REFERENCES

Alling, A. K. and H. P. Whitehead. 1987. A preliminary study of the status of white-beaked dolphins, *Lagenorhynchus albirostris*, and other small cetaceans off the coast of Labrador. Can. Fld. Nat. 101(2): 131-135.

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.

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

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 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.

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.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

COMMON DOLPHIN (*Delphinus delphis*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The common dolphin may be one of the most widely distributed species of cetaceans, as it is found world-wide in temperate, tropical, and subtropical seas. In the North Atlantic, common dolphins appears to be present along the coast over the continental shelf along the 200-300 m isobaths or over prominent underwater topography from 50° N to 40°S latitude (Evans 1994). The species is less common south of Cape Hatteras, although schools have been reported as far south as eastern Florida (Gaskin 1992). At least some of the reported sightings of common dolphins in the Gulf of Mexico may have been *Stenella clymene*, which has a color pattern similar to that of common dolphins (Evans 1994). Information regarding common dolphin stock structure in the western North Atlantic does not exist. However, a high variance in skull morphometric measurements suggests the existence of more than a single stock (J. G. Mead, personal communication).

Common dolphins are distributed in broad bands along the continental slope (100 to 2,000 meters), and are associated with other Gulf Stream features in waters off the northeastern U.S. coast (CeTAP 1982; Selzer and Payne 1988; Waring et al 1992). They are widespread from Cape Hatteras northeast to Georges Bank (35º to 42º North latitude) in outer continental shelf waters from mid-January to May (Hain et al. 1981; CeTAP 1982; Payne et al. 1984). Common dolphins move northward onto Georges Bank and the Scotian Shelf from mid-summer to autumn. Selzer and Payne (1988) reported very large aggregations (greater than 3,000 animals) on Georges Bank in autumn. Common dolphins are rarely found in the Gulf of Maine, where temperature and salinity regimes are lower than on the continental slope of the Georges Bank/mid-Atlantic region (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11°C (Sergeant et al. 1970).

POPULATION SIZE

The total number of common dolphins off the eastern U.S. and Canadian Atlantic coast is unknown, although several estimates from selected regions do exist. Seasonal abundance estimates are available from an aerial line transect survey program conducted in continental shelf and continental shelf edge waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982). R. Kenney (personal communication) provided abundance estimates that accounted for survey effort in two continental slope survey blocks and uncertainties resulting from sightings of unidentified small dolphins. An estimate based on an inverse variance weighted pooling of revised CeTAP (1982) spring and summer data is 29,610 (CV = 0.39). An average for these two seasons was chosen because the greatest proportion of the population off the northeast U.S. coast appears to be in the CeTAP study area in these seasons. This estimate was not corrected for g(0), the probability of detecting an animal group on the trackline.

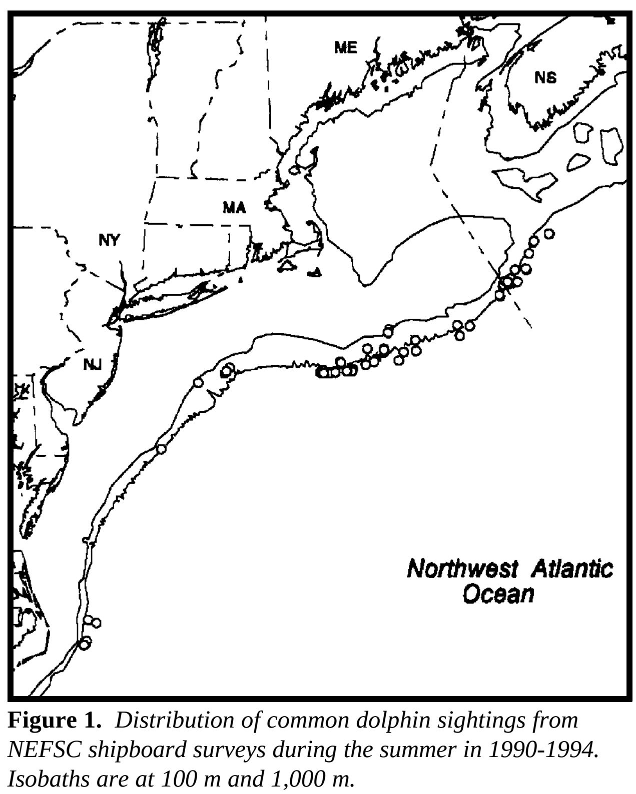


Figure 1. *Distribution of common dolphin sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

More recent abundance estimates were derived using data collected during two fine-scale ship line transect surveys (June-July 1991 and June-July 1993) conducted in continental shelf edge and deeper oceanic waters (Northeast Fisheries Science Center NMFS unpublished data). Common dolphin sightings during these surveys are shown in Figure 1. The data were analyzed using DISTANCE (Buckland et al. 1993; Laake et al. 1993) where confidence intervals were calculated using the bootstrap lognormal method. An abundance estimate from the 1991 survey, based principally on sighting effort conducted between the 200 and 2,000 meter isobaths from Cape Hatteras to Georges Bank was 4,984 common dolphins (CV = 0.55). The estimate for the 1993 survey, conducted principally between the 200 and 2,000 meter isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southwestern edge of the Scotian Shelf was 1,645 common dolphins (CV = 0.47).

Although the 1991 and 1993 surveys did not sample the same areas or encompass the entire common dolphin habitat (e. g., little effort in mid-continental shelf waters), they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The 1991 and 1993 data suggest that, seasonally, at least several thousand common dolphins are occupying continental shelf edge waters, with perhaps highest abundance in the Georges Bank region. This is consistent with the earlier CeTAP data from a decade previous. Survey coverage to date is not adequate to provide a definitive estimate of common dolphin abundance for the western North Atlantic and because the estimates presented here were not corrected for school size bias and g(0), they probably underestimate actual abundance.

Minimum Population Estimate

The minimum population estimate was based on the 1991 shipboard survey abundance estimate of 4,984 common dolphins (CV = 0.55) (NMFS unpublished data). This estimate was selected because it provided the most complete coverage of common dolphin habitat off the northeast U.S. coast. The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994), and was 3,233 common dolphins.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

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 0.50 because of the stock's status relative to its OSP level is unknown. PBR for this stock is 32 common dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

During the period 1977-1986, observers recorded 123 mortalities in foreign *Loligo* squid-fishing activities (Waring et al. 1990). In 1985 and 1986, Italian vessels took 56 and 54 animals, respectively, which accounts for 89% (n = 110) of the total takes in foreign *Loligo* squid-fishing operations. No mortalities were reported in foreign *Illex* squid fishing operations. Because of spatial/temporal fishing restrictions, most of the by-catch occurred along the continental shelf edge (100 m) isobath during winter (December to February).

From 1977-1991, observers recorded 110 mortalities in foreign mackerel-fishing operations (Waring et al. 1990; NMFS unpublished data). This total includes one documented take by a U.S. vessel involved in joint-venture fishing operations in which U.S. captains transfer their catches to foreign processing vessels. The by-catch occurred during winter/spring (December to May).

Incidental mortality has also been observed in the pelagic drift gillnet and pair trawl fisheries (see below) off the U.S. Atlantic coast. No mortalities were documented in the Atlantic swordfish/tuna/shark longline, New England multispecies sink gillnet, and groundfish trawl observed fisheries. An unknown number of common dolphins have been taken in an experimental salmon drift-gillnet fishery off Greenland (Read 1994). In general, there is little known regarding historical or current common dolphin by-catch in Canadian fisheries.

Estimated average annual mortality and serious injury for all of the NMFS-observed fisheries is 449 common dolphins per year (CV = 0.47). 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 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.

Fisheries Information

Prior to 1977, there was no documentation of marine mammal by-catch in distant-water fleet (DWF) activities off the northeast coast of the U.S. With implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA), an observer program was established which has recorded fishery data and information of incidental by-catch of marine mammals. DWF effort in the Atlantic coast Exclusive Economic Zone (EEZ) under MFCMA has been directed primarily towards Atlantic mackerel and squid. From 1977 through 1982, an average of 120 different foreign vessels per year (range 102-161) operated within the Atlantic coast EEZ. In 1982, there were 112 different foreign vessels; 16%, or 18, were Japanese tuna longline vessels operating along the U.S. 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 1991, the numbers of foreign vessels operating within the Atlantic coast EEZ each year were 67, 52, 62, 33, 27, 26, 14, 13, and 9, respectively. Between 1983 and 1988, the numbers of DWF vessels included 3, 5, 7, 6, 8, and 8, respectively, Japanese longline vessels. Observer coverage on DWF vessels was 25-35% during 1977-82, and increased to 58%, 86%, 95%, and 98%, respectively, in 1983-86. From 1987-91, 100% observer coverage was maintained. Foreign fishing operations for squid and mackerel ceased at the end of the 1986 and 1991 fishing seasons, respectively.

The Canadian and Greenland salmon gillnet fishery is seasonal, with the peak from June to September, depending on location. In southern and eastern Newfoundland, and Labrador during 1989, 2,196 nets 91 m long were used. The fishery was terminated in 1993 (Read 1994).

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook 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 provides observer coverage of vessels fishing south of Cape Hatteras.

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Atlantic and Gulf of Mexico. This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. Total longline effort for the Atlantic pelagic fishery (including the Caribbean), based on mandatory logbook reporting, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). There was no reported fishery-related mortality or serious injury to this stock attributable to this fishery.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). Three hundred and seven common dolphin mortalities were observed between 1989 and 1993 in this fishery. Mortalities were observed in all seasons and areas. Five animals were released alive, but four were injured. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 540 in 1989 (0.55), 893 in 1990 (0.40), 223 in 1991 (0.36), 227 in 1992 (0.20), and 238 in 1993 (0.16); average annual estimated fishery-related mortality during 1989-1993 attributable to this fishery was 424 common dolphins (0.50).

During the period 1989 to 1993, effort in the Atlantic swordfish/tuna/shark pair trawl fishery increased from zero hauls in 1989 and 1990, to an estimated 171 hauls in 1991 and then to an estimated 989 and 1,087 hauls in 1992 and 1993, respectively. The fishery operated from August to November in 1991, from June to November in 1992, and from June to October in 1993. Sea sampling began in October of 1992 where 101 sets (10% of the total) were sampled. In 1993, 201 hauls (18% of the total) were sampled. Nineteen vessels have operated in this fishery. The fishery operates in the area between 35°N to 41°N and 69°W to 72°W. Approximately 50% of the total effort was within a one degree square at 39°N, 72°W, around Hudson Canyon. Examination of the locations and species composition of the by-catch, showed little seasonal change for the six months of operation and did not warrant any seasonal or areal stratification of this fishery. Nine mortalities were observed between 1991 and 1993. The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 5.6 in 1991 (0.53), 32 in 1992 (0.48), and 35 in 1993 (0.43). Average annual estimate fishery-related mortality attributable to this fishery during 1991-1993 was 24 common dolphins (CV = 0.52).

STATUS OF STOCK

The status of common dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. This is a strategic stock because average annual fishery-related mortality and serious injury exceeds PBR.

REFERENCES

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.

Buckland, S. T., D. R. Andersen, K. P. Burnham, and J. L. Laake. 1993. Distance Sampling: Estimating abundance of biological populations. Chapman and Hall, New York, 446 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, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

Evans, W. E. 1994. Common dolphin, white-bellied porpoise. Pages 191-224 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Volume 5: The first book of dolphins. Academic Press, San Diego

Gaskin, D. E. 1992. Status of common dolphin, *Delphinus delphis*, in Canada. Can. Fld. Nat. 106: 55-63.

Hain, J. H. W., R. K. Edel, H. E. Hays, S. K. Katona, and J. D. Roanowicz. 1981. General distribution of cetaceans in the continental shelf waters of the northeastern U.S. Pages II1-II277 *in* CeTAP (Cetacean and Turtle Assessment program), A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf, Annual Report for 1979. Contract No. AA551-CT8-48, U.S. Dept. of Interior, Bureau of Land Management, Washington, DC.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S., D. K. Caldwell, and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 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., L. A. Selzer, and A. R. Knowlton. 1984. Distribution and density of cetaceans, marine turtles, and seabirds in the shelf waters of the northeastern United States, June 1980-December 1983, based on shipboard observations. NOAA/NMFS Contract No. NA-81-FA-C-00023.

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.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

Selzer, L. A. and P. M. Payne. 1988. The distribution of white-sided (*Lagenorhynchus acutus*) and common dolphins (*Delphinus delphis*) vs. environmental features of the continental shelf of the northeastern United States. Mar. Mamm. Sci. 4(2): 141-153.

Sergeant, D. E., A. W. Mansfield and B. Beck. 1970. Inshore records of cetacea for eastern Canada, 1949-68. J. Fish. Res. Bd. Can. 27: 1903-1915.

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.

Waring, G. T., C. P. Fairfield, C. M. Ruhsam and M. Sano. 1992. Cetaceans associated with Gulf Stream features off the northeastern USA shelf. ICES Marine Mammals Comm. CM 1992/N: 12, 29 pp.

ATLANTIC SPOTTED DOLPHIN (*Stenella frontalis*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of spotted dolphin in the Western Atlantic — the Atlantic spotted dolphin, *Stenella frontalis*, formerly *S. plagiodon* (Perrin et al. 1987), and the pantropical spotted dolphin, *S. attenuata*. These species are difficult to differentiate at sea.

Atlantic spotted dolphins are distributed in tropical and warm temperate waters of the western North Atlantic (Leatherwood et al. 1976). Their distribution is from southern New England, south through the Gulf of Mexico and the Caribbean to Venezuela (Leatherwood et al. 1976; Perrin et al. 1987). The large, heavily spotted form of the Atlantic spotted dolphin along the southeastern and Gulf coasts of the United States inhabits the continental shelf, usually being found inside or near the 200 m isobath (within 250-350 km of the coast) but sometimes coming into very shallow water adjacent to the beach. Off the northeast U.S. coast, spotted dolphins are widely distributed on the continental shelf, along the continental shelf edge, and offshore over the deep ocean south of 40º N (CeTAP 1982). Atlantic spotted dolphins regularly occur in the inshore waters south of Chesapeake Bay and near the continental shelf edge and continental slope waters north of this region (Payne et al. 1984). Sightings have also been made along the north wall of the Gulf Stream and warm-core ring features (Waring et al. 1992). Stock structure in the western North Atlantic is unknown.

POPULATION SIZE

The total number of spotted dolphins off the eastern U.S. coast is unknown. Seasonal abundance estimates for a portion of the known range are available from an aerial line transect survey program conducted in the continental shelf and continental shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia from 1978 to 1982 (CeTAP 1982). R. Kenney (personal communication) provided abundance estimates for both species of spotted dolphins combined that accounted for survey effort in two continental slope survey blocks and uncertainties resulting from sightings of unidentified small dolphins. An estimate based on inverse variance-weighted pooling of the revised CeTAP (1982) spring and summer data is 6,107 spotted dolphins (CV = 0.27). An average for these two seasons was chosen because the greatest proportion of the population off the northeast U.S. coast appears to be in the CeTAP study area in these seasons. This estimate was not corrected for g(0), the probability of detecting dolphins on the trackline. Furthermore, this survey did not cover important spotted dolphin habitat in the continental shelf between Cape Hatteras and Florida, and Atlantic deep oceanic waters.

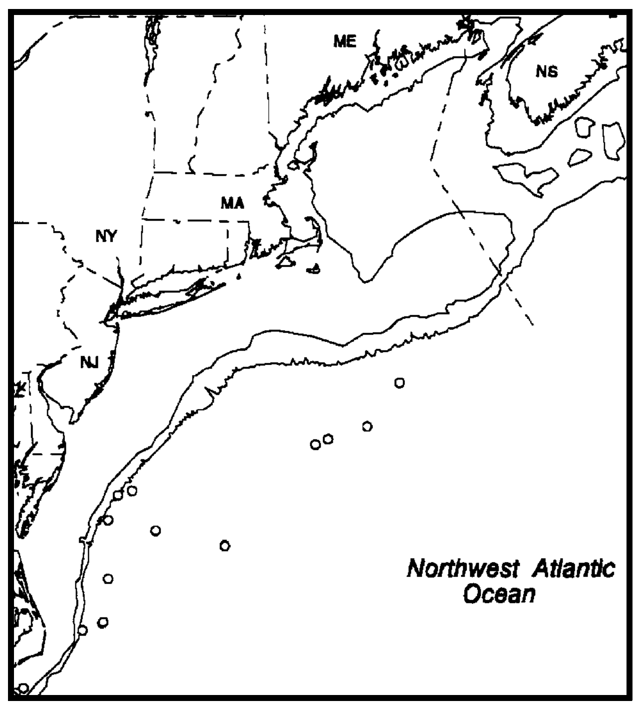


Figure 1. *Distribution of spotted dolphin sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

Spotted dolphin sighting data were collected during the autumn 1991 aerial line transect survey in the CeTAP study area and from several fine-scale ship line transect surveys (August 1990, June-July 1991 and June-July 1993) conducted in continental shelf edge and deeper oceanic waters (NMFS unpublished data). Spotted dolphin sightings during these surveys are shown in Figure 1. These data were too limited for use in estimating abundance because these surveys did not adequately sample spotted dolphin high-use habitats off the northeastern U.S. coast.

Minimum Population Estimate

The minimum population estimate for both species of spotted dolphins combined was based on the CeTAP (1982) abundance estimate which was 6,107 spotted dolphins (CV = 0.27). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate and was 4,885 spotted dolphins. 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 to determine the population trends for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

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 0.16 because of the stock's status relative to OSP is unknown and the minimum population estimate is 11 years older than the latest fishery-related mortality estimate. PBR for both species of spotted dolphins combined would be sixteen; however, it is inappropriate to calculate a PBR for the Atlantic spotted dolphin (*S. Frontalis*) stock because it was impossible to separately identify the two species.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No spotted dolphin mortalities were observed in 1977-1991 foreign fishing activities. Nineteen mortalities have been documented between 1989 and 1993 (see below) in the pelagic drift gillnet fishery. Six whole animal carcasses that were sent to the Smithsonian were identified as Pantropical spotted dolphins (*Stenella attenuata*). The remaining 13 animals were not identified to species. No mortalities were documented in the Atlantic swordfish/tuna/shark pair trawl, New England multispecies sink gillnet, and groundfish trawl fisheries; and no takes have been documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Total annual estimated average fishery-related mortality and serious injury to both species of spotted dolphins combined in the Atlantic by both fisheries is 31 spotted dolphins (CV = 1.13). 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 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.

Fisheries Information

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook 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 provides observer coverage of vessels fishing south of Cape Hatteras. Total fishery-related mortality and serious injury cannot be estimated separately for the two species of spotted dolphins in the U.S. Atlantic Exclusive Economic Zone (EEZ) because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury.

Pelagic swordfish, tunas, and billfish are the targets of the U.S. longline fishery in the U.S. Atlantic and Gulf of Mexico EEZ (SEFSC unpublished logbook data). Interactions between the longline swordfish/tuna fishery and spotted dolphins have been reported; however, a vessel may fish in more than one statistical reporting area and it is not possible to separate estimates of fishing effort other than to subtract Gulf of Mexico effort from Atlantic fishing effort, which includes the Caribbean Sea. This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. Total longline effort for the Atlantic pelagic fishery (including the Caribbean), based on mandatory logbook reporting, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery (SEFSC unpublished data). Annual estimates of mortality and serious injury were based on observed takes across the entire Atlantic longline swordfish/tuna fishery (including the Gulf of Mexico). All observed takes were used because the species occurs throughout area of the fishery, but observed takes were infrequent in any given region of the fishery. There was no mortality or serious injury reported in 1992 and estimated fishery-related mortality and serious injury to spotted dolphins (both species) in the Atlantic longline swordfish/tuna fishery in 1993 was 16 (CV = 0.19); average annual mortality and serious injury attributable to this fishery in 1992-1993 was 8.0 spotted dolphins (CV = 0.27).

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). Nineteen spotted dolphin mortalities were observed in the drift gillnet fishery between 1989 and 1993 and occurred northeast of Cape Hatteras within the 183 m isobath in February-April, and near Lydonia Canyon in October. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 23 in 1989 (2.14), 51 in 1990 (1.12), 11 in 1991 (1.21), 20 in 1992 (0.35), and 8.4 in 1993 (0.79).

STATUS OF STOCK

The status of Atlantic spotted dolphins, relative to OSP in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. This is a strategic stock because the average annual fishery-related mortality and serious injury of spotted dolphins would exceed PBR for this stock (if it could be calculated) even if the minimum population estimate for spotted dolphins were exclusively *S. Frontalis*.

REFERENCES

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, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 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., L. A. Selzer and A. R. Knowlton. 1984. Distribution and density of cetaceans, marine turtles, and seabirds in the shelf waters of the northeastern United States, June 1980-December 1983, based on shipboard observations. NOAA/NMFS Contract No. NA-81-FA-C-00023.

Perrin, W. F.,E. D. Mitchell, J. G. Mead, D. K. Caldwell, M. C. Caldwell, P. J. H. van Bree, and W. H. Dawbin. 1987. Revision of the spotted dolphins, *Stenella* spp. Mar. Mamm. Sci. 3(2): 99-170.

Perrin, W. F., D. K. Caldwell, and M. C. Caldwell. 1994. Atlantic spotted dolphin. Pages 173-190 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Volume 5: The first book of dolphins. Academic Press, San Diego, 418 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.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

Waring, G. T., C. P. Fairfield, C. M. Ruhsam and M. Sano. 1992. Cetaceans associated with Gulf Stream features off the northeastern USA shelf. ICES Marine Mammals Comm. CM 1992/N:12, 29 pp.

PANTROPICAL SPOTTED DOLPHIN (*Stenella attenuata*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of spotted dolphin in the Western Atlantic — the Atlantic spotted dolphin, *Stenella frontalis*, formerly *S. plagiodon* (Perrin et al. 1987), and the pantropical spotted dolphin, *S. attenuata*. These species are difficult to differentiate at sea.

The pantropical spotted dolphin is distributed worldwide in tropical and some sub-tropical oceans (Perrin et al. 1987; Perrin and Hohn 1994). Sightings of this species in the northern Gulf of Mexico occur over the deeper waters, and rarely over the continental shelf or continental shelf edge (Mullin et al. 1991; Southeast Fisheries Science Center, SEFSC, unpublished data). Pantropical spotted dolphins were seen in all seasons during recent seasonal aerial surveys of the northern Gulf of Mexico, and during recent winter aerial surveys offshore of the southeastern U.S. Atlantic coast (SEFSC unpublished data). Some of the Pacific populations have been divided into different geographic stocks based on morphological characteristics (Perrin et al. 1987; Perrin and Hohn 1994); however, there is no information on stock differentiation in the Atlantic population.

POPULATION SIZE

The total number of spotted dolphins off the eastern U.S. coast is unknown. Seasonal abundance estimates are available from an aerial line transect survey program conducted in the continental shelf and continental shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia from 1978 to 1982 (CeTAP 1982). R. Kenney (personal communication) provided abundance estimates for both species of spotted dolphins combined that accounted for survey effort in two continental slope survey blocks and uncertainties resulting from sightings of unidentified small dolphins. An estimate based on inverse variance-weighted pooling of the revised CeTAP (1982) spring and summer data is 6,107spotted dolphins (CV = 0.27). An average for these two seasons was chosen because the greatest proportion of the population off the northeast U.S. coast appears to be in the CeTAP study area in these seasons. This estimate was not corrected for g(0), the probability of detecting dolphins on the trackline. Furthermore, this survey did not cover important spotted dolphin habitat in the continental shelf between Cape Hatteras and Florida, or in oceanic waters.

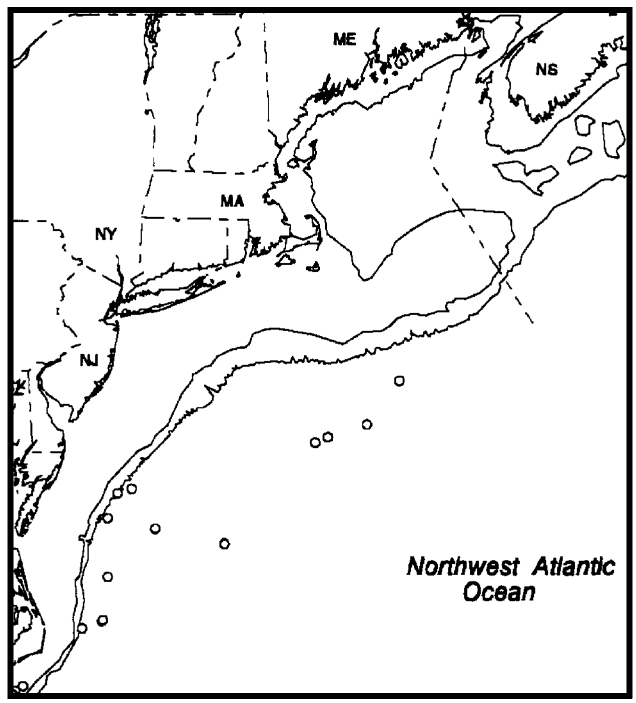


Figure 1. *Distribution of spotted dolphin sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

Spotted dolphin sighting data were collected during the autumn 1991 aerial line transect survey in the CeTAP study area and from several fine-scale ship line transect surveys (August 1990, June-July 1991 and June-July 1993) conducted in continental shelf edge and deeper oceanic waters (NMFS unpublished data). Spotted dolphin sightings during these surveys are shown in Figure 1. These data were too limited for use in estimating abundance because these surveys did not adequately sample spotted dolphin high-use habitats off the northeastern U.S. coast.

Minimum Population Estimate

The minimum population estimate for both species of spotted dolphins combined was based on the CeTAP (1982) abundance estimate which was 6,107 spotted dolphins (CV = 0.27). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate and was 4,885 spotted dolphins. 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 to determine the population trends for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

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 0.16 because of the stock's status relative to OSP is unknown and the minimum population estimate is 11 years older than the latest fishery-related mortality estimate. PBR for both species of spotted dolphins combined would be sixteen; however, it is inappropriate to calculate a PBR for the pantropical spotted dolphin (*S. attenuata*) stock because it was impossible to separately identify the two species.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No spotted dolphin mortalities were observed in 1977-1991 foreign fishing activities. Nineteen mortalities have been documented between 1989 and 1993 (see below) in the pelagic drift gillnet fishery. Six whole animal carcasses that were sent to the Smithsonian were identified as pantropical spotted dolphins (*S. attenuata*). The remaining 13 animals were not identified to species. No mortalities were documented in the Atlantic swordfish/tuna/shark pair trawl, New England multispecies sink gillnet, and groundfish trawl fisheries; and no takes have been documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Total annual estimated average fishery-related mortality and serious injury to both species of spotted dolphins combined in the Atlantic by both fisheries is 31 spotted dolphins (CV = 1.13). 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 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.

Fisheries Information

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook 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 provides observer coverage of vessels fishing south of Cape Hatteras. Total fishery-related mortality and serious injury cannot be estimated separately for the two species of spotted dolphins in the U.S. Atlantic Exclusive Economic Zone (EEZ) because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury.

Pelagic swordfish, tunas, and billfish are the targets of the U.S. longline fishery in the U.S. Atlantic and Gulf of Mexico EEZ (SEFSC unpublished logbook data). Interactions between the longline swordfish/tuna fishery and spotted dolphins have been reported; however, a vessel may fish in more than one statistical reporting area and it is not possible to separate estimates of fishing effort other than to subtract Gulf of Mexico effort from Atlantic fishing effort, which includes the Caribbean Sea. This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. Total longline effort for the Atlantic pelagic fishery (including the Caribbean), based on mandatory logbook reporting, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery (SEFSC unpublished data). Annual estimates of mortality and serious injury were based on observed takes across the entire Atlantic longline swordfish/tuna fishery (including the Gulf of Mexico). All observed takes were used because the species occurs generally throughout area of the fishery, but observed takes were infrequent in any given region of the fishery. There was no mortality or serious injury reported in 1992 and estimated fishery-related mortality and serious injury to spotted dolphins (both species) in the Atlantic longline swordfish/tuna fishery in 1993 was 16 (CV = 0.19); average annual mortality and serious injury attributable to this fishery in 1992-1993 was 8.0 spotted dolphins (CV = 0.27).

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch were obtained for each year using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). Nineteen spotted dolphin mortalities were observed in the drift gillnet fishery between 1989 and 1993 and occurred northeast of Cape Hatteras within the 183 m isobath in February-April, and near Lydonia Canyon in October. Estimated annual mortality and serious injury of spotted dolphins (both species) attributable to this fishery (CV in parentheses) was 23 in 1989 (2.14), 51 in 1990 (1.12), 11 in 1991 (1.21), 20 in 1992 (0.35), and 8.4 in 1993 (0.79).

STATUS OF STOCK

The status of pantropical spotted dolphins, relative to OSP in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. This is a strategic stock because the average annual fishery-related mortality and serious injury of spotted dolphins would exceed PBR for this stock (if it could be calculated) even if the minimum population estimate for spotted dolphins were exclusively *S. attenuata*.

REFERENCES

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, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana, 108 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.

Perrin, W. F.,E. D. Mitchell, J. G. Mead, D. K. Caldwell, M. C. Caldwell, P. J. H. van Bree, and W. H. Dawbin. 1987. Revision of the spotted dolphins, *Stenella* spp. Mar. Mamm. Sci. 3(2): 99-170.

Perrin, W. F., D. K. Caldwell, and M. C. Caldwell. 1994. Atlantic spotted dolphin. Pages 173-190 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Volume 5: The first book of dolphins. Academic Press, San Diego, 418 pp.

Perrin, W. F. and A. A. Hohn. 1994. Pantropical spotted dolphin *Stenella attenuata*. Pages 71-98 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, San Diego, 418 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.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

STRIPED DOLPHIN (*Stenella coeruleoalba*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The striped dolphin, *Stenella coeruleoalba*, is distributed worldwide in temperate and tropical seas of the world. Striped dolphins are found in the western North Atlantic from Nova Scotia south to at least Jamaica and in the Gulf of Mexico. In general, striped dolphins appear to prefer continental slope waters offshore to the Gulf Stream (Leatherwood et al. 1976; Perrin et al. 1994; Schmidly 1981). There is no information concerning striped dolphin stock structure in the western North Atlantic.

In waters off the northeastern U.S. coast, striped dolphins are distributed along the continental shelf edge from Cape Hatteras to the southern margin of Georges Bank, and also occur offshore over the continental slope and rise in the mid-Atlantic region (CeTAP 1982). Continental shelf edge sightings in this program were generally centered along the 1,000 m depth contour in all seasons (CeTAP 1982). During 1990 and 1991 cetacean habitat-use surveys, striped dolphins were associated with the Gulf Stream north wall and warm-core ring features (Waring et al. 1992).

POPULATION SIZE

The total number of striped dolphins in the U.S. Exclusive Economic Zone (EEZ) is unknown. Seasonal abundance estimates are available from an aerial line transect survey program conducted in the continental shelf and continental shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia from 1978 to 1982 (CeTAP 1982). R. Kenney (personal communication) provided abundance estimates that accounted for survey effort in two continental slope survey blocks and uncertainties resulting from sighting of unidentified small dolphins. An estimate based on an inverse variance weighted pooling of revised CeTAP (1982) spring and summer data is 36,780 (CV = 0.27). An average for these two seasons was chosen because the greatest proportion of the population off the northeast U.S. coast appears to be in the CeTAP study area in these seasons. This estimate was not corrected for g(0), the probability of detecting an animal group on the trackline.

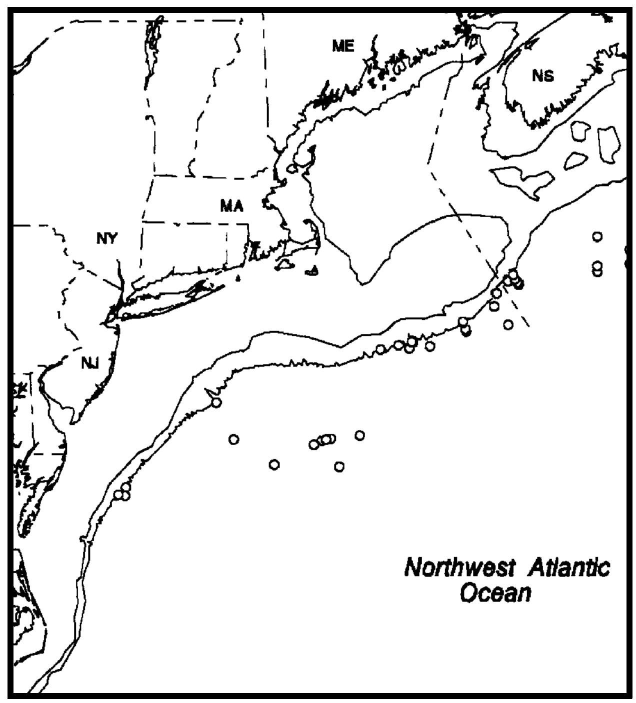


Figure 1. *Distribution of striped dolphin sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

Abundance estimates were also derived using data collected during an autumn 1991 aerial line transect survey in the CeTAP study area (NMFS unpublished data), which included an interplatform experiment between a Twin Otter and an AT-11). Sightings were almost exclusively in the continental shelf edge waters. The data were analyzed using DISTANCE (Buckland et al. 1993; Laake et al. 1993) where confidence intervals were calculated using the bootstrap lognormal method. Abundance estimates, based on a low number of sightings, from this survey were 13,157 (CV = 0.45) and 25,939 (CV = 0.36), respectively, for the AT-11 and NOAA Twin Otter. Data were not pooled, because the interplatform calibration analysis has not been conducted. These estimates are not comparable to the CeTAP estimates, because the 1991 data are from a single survey conducted during August-October, while the CeTAP estimates were based on data pooled over several years of seasonal surveys.

Striped dolphin sighting data were also collected during three fine-scale ship line transect surveys (August 1990, June-July 1991, and June-July 1993) conducted in continental shelf edge and deeper oceanic waters (NMFS unpublished data) and striped dolphin sightings during these surveys are shown in Figure 1. These data were too limited for use in estimating abundance because these surveys did not adequately sample striped dolphin high-use habitats off the northeastern U.S. coast.

Minimum Population Estimate

The minimum population estimate was based on the AT-11 aerial survey abundance estimate of 13,157 striped dolphins (CV = 0.45) (NMFS unpublished data) in 1991. This estimate was used because that survey provided the most complete coverage of continental shelf edge and continental slope waters off the northeast U.S. coast. The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994), and was 9,165 striped dolphins.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

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 0.40 because of the high variance (CV = 1.30) associated with the estimated total annual fishery-related mortality and serious injury for striped dolphins. PBR for this stock is 73 striped dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No mortalities were observed in 1977-1991 foreign fishing activities off the northeast U.S. coast. Nineteen mortalities were documented between 1989 and 1993 (see below) in the pelagic drift-gillnet fishery, and two mortalities were documented in 1991 in the New England groundfish trawl fishery. No mortalities were documented in the Atlantic swordfish/tuna/shark longline, Atlantic swordfish/tuna/shark pair trawl and New England multispecies sink gillnet fisheries. Also, no takes have been documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Total estimated average annual fishery-related mortality and serious injury to this stock in the Atlantic during 1989-1993 was 63 striped dolphins annually (CV = 1.30). The total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and cannot be considered to be 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.

Fisheries Information

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook 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 provides observer coverage of vessels fishing south of Cape Hatteras.

Pelagic swordfish, tunas, and billfish are the targets of the U.S. longline fishery in the U.S. Atlantic and Gulf of Mexico EEZ (SEFSC unpublished logbook data). Interactions between the longline swordfish/tuna fishery and striped dolphins have been reported; however, a vessel may fish in more than one statistical reporting area and it is not possible to separate estimates of fishing effort other than to subtract Gulf of Mexico effort from Atlantic fishing effort, which includes the Caribbean Sea. This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. Total longline effort for the Atlantic pelagic fishery (including the Caribbean), based on mandatory logbook reporting, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 sets in 1993 (Cramer 1994). There were no reported human-caused mortality or serious injury to this stock by this fishery.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). Nineteen striped dolphin mortalities were observed in this fishery between 1989 and 1993 and occurred east of Cape Hatteras in January and February, and along the southern margin of Georges Bank in summer and autumn. Estimated annual mortality and serious injury (CV in parentheses) attributable to this fishery was 39 striped dolphins in 1989 (0.84), 57 in 1990 (0.73), ten in 1991 (0.87), 7.7 in 1992 (0.65), and 21 in 1993 (0.20). The 1989-1993 average annual mortality and serious injury to striped dolphins in the Atlantic large pelagic drift gillnet fishery was 27 dolphins (0.90).

Vessels in the New England groundfish multispecies trawl fishery, a Category III fishery under the MMPA, were observed in order to meet fishery management needs, rather than marine mammal management needs. An average of 970 (CV = 0.04) vessels (full and part time) participated annually in the fishery during 1989-1993. The fishery is active in New England waters in all seasons. The only reported fishery-related mortalities (two) occurred in 1991. Total estimated mortality and serious injury attributable to this fishery in 1991 was 181 (CV = 0.97); average annual mortality and serious injury during 1989-1993 was 36 striped dolphins (CV = 2.17).

STATUS OF STOCK

The status of striped dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. Average annual fishery-related mortality and serious injury does not exceed the PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Andersen, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman and Hall, New York, 446 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, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dept. of Commerce, NOAA Tech. Rep. NMFS Circ. 396, 176 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.

Perrin, W. F., C. E. Wilson, and F. I. Archer II. 1994. Pages 129-159 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Volume 5: The first book of dolphins, Academic Press, San Diego.

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.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

Schmidly, D. J. 1981. Marine mammals of the southeastern United States coast and the Gulf of Mexico. Pub. No. FWS/OBS-80/41, U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC, 163 pp.

Waring, G. T., C. P. Fairfield, C. M. Ruhsam and M. Sano. 1992. Cetaceans associated with Gulf Stream features off the northeastern USA shelf. ICES Marine Mammals Comm. CM 1992/N:12, 29 pp.

SPINNER DOLPHIN (*Stenella longirostris*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Spinner dolphins are distributed in oceanic and coastal tropical waters (Leatherwood et al. 1976). This is presumably an offshore, deep-water species (Schmidly 1981; Perrin and Gilpatrick 1994), and its distribution in the Atlantic is very poorly known. In the western North Atlantic, these dolphins occur in deep water along most of the U.S. coast south to the West Indies and Venezuela, including the Gulf of Mexico. Spinner dolphin sightings have occurred exclusively in deeper (>2,000 m) oceanic waters (CeTAP 1982; Waring et al. 1992) off the northeast U.S. coast. Stranding records exist from North Carolina, South Carolina, and Florida in the Atlantic and in Texas and Florida in the Gulf of Mexico. The North Carolina strandings represent the northernmost documented distribution of this species in the Atlantic. Stock structure in the western North Atlantic is unknown.

POPULATION SIZE

The number of spinner dolphins inhabiting the U.S. Atlantic Exclusive Economic Zone (EEZ) is unknown and seasonal abundance estimates are not available for this species since it was rarely seen in the CeTAP (1982) study area.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

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 not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

POTENTIAL BIOLOGICAL REMOVAL

No PBR can be estimated for this species at this time, because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

One mortality has been observed in the large pelagic drift-gillnet fishery. No takes were documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Total average annual estimated average fishery-related mortality and serious injury to this stock in the Atlantic during 1989-1993 was 1.0 spinner dolphin (CV = 3. 07). PBR cannot be calculated for this stock, but there is fishery-related mortality and serious injury; therefore, total fishery-related mortality and serious injury 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.

Fisheries Information

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries and the data 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 provides observer coverage of vessels fishing south of Cape Hatteras.

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Atlantic and Gulf of Mexico. Effort for the western North Atlantic pelagic longline fishery totaled approximately 5.3 million hooks set by 281 vessels in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There was no reported fishery-related mortality or serious injury to this stock attributable to the pelagic longline fishery.

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). One spinner dolphin mortality was observed between 1989 and 1993 and occurred east of Cape Hatteras in March 1993. Estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 0.7 in 1989 (7. 00), 1.7 in 1990 (2.65), 0.7 in 1991 (2.00), 1.4 in 1992 (0.61), and 0.5 in 1993 (0.89).

STATUS OF STOCK

The status of spinner dolphins relative to OSP in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. Population size and PBR cannot be estimated, but fishery-related mortality is very low; therefore, this stock is not a strategic stock.

REFERENCES

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.

Perrin, W. F. and J. W. Gilpatrick, Jr. 1994. Spinner dolphin. Pages 99-128 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Volume 5: The first book of dolphins. Academic Press, San Diego, 418 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.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

Schmidly, D. J. 1981. Marine mammals of the southeastern United States coast and the Gulf of Mexico. Pub. No. FWS/OBS-80/41, U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC, 163 pp.

Waring, G. T., C. P. Fairfield, C. M. Ruhsam and M. Sano. 1992. Cetaceans associated with Gulf Stream features off the northeastern USA shelf. ICES Marine Mammals Comm. CM 1992/N:12, 29 pp.

BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Western North Atlantic Offshore Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two hematologically and morphologically distinct bottlenose dolphin ecotypes (Duffield et al. 1983; Duffield 1986) which correspond to a shallow, warm water ecotype and a deep, cold water ecotype; both ecotypes have been shown to inhabit waters in the western North Atlantic Ocean (Hersh and Duffield 1990).

Bottlenose dolphins which had stranded alive in the western North Atlantic in areas with direct access to deep oceanic waters had hemoglobin profiles which matched that of the deep, cold water ecotype (Hersh and Duffield 1990). Hersh and Duffield (1990) also described morphological differences between the deep, cold water ecotype dolphins and dolphins with hematological profiles matching the shallow, warm water ecotype which had stranded in the Indian/Banana River in Florida. Based on the distribution of sightings during ship-based surveys (Fig. 1) and survey personnel observations (NMFS unpublished data), the western North Atlantic offshore stock is believed to consist of bottlenose dolphins corresponding to the hematologically and morphologically distinct deep, cold water ecotype.

Extensive aerial surveys in 1979-1981 indicated that the stock extended along the entire continental shelf break from Georges Bank to Cape Hatteras during spring and summer (CeTAP 1982; Kenney 1990). The distribution of sightings contracted towards the south in the fall and the central portion of the survey area was almost devoid of sightings in the winter, although there were still sightings as far north as the southern edge of Georges Bank. The offshore stock is concentrated along the continental shelf break in waters of depths > 25 m and extends beyond the continental shelf into continental slope waters in lower concentration (Fig. 1) (Kenney 1990). No distribution or abundance data are available from Canadian waters. Dolphins with characteristics of the offshore type have been stranded as far south as the Florida Keys, but there are no abundance or distribution estimates available for this stock in U.S. Exclusive Economic Zone (EEZ) waters south of Cape Hatteras.

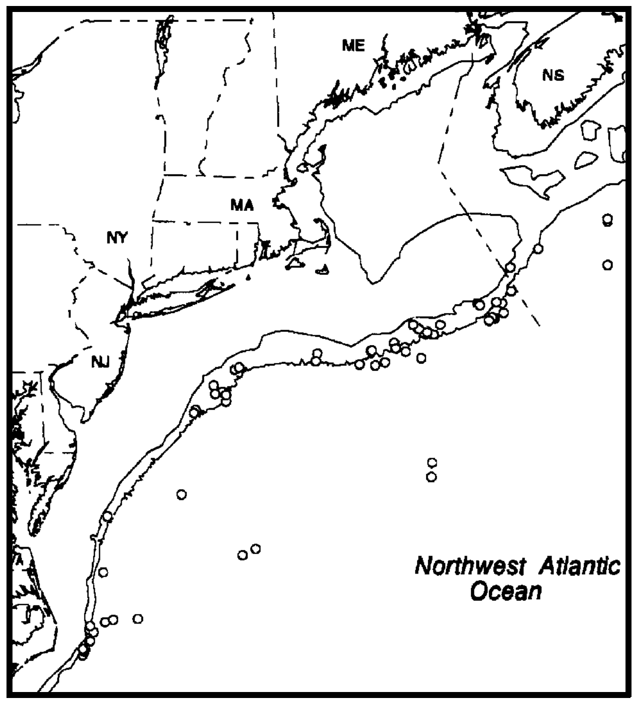


Figure 1. *Distribution of bottlenose dolphin sightings from NEFSC shipboard surveys during the summer in 1990-1994. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

The total number of bottlenose dolphins off the Atlantic U.S. coast is unknown. Historical seasonal abundance estimates are available from an aerial survey program conducted in the continental shelf waters between Cape Hatteras, North Carolina, and Nova Scotia from 1978 to 1982 (CeTAP 1982). The peak average estimated abundance of the offshore stock occurred in the fall and was estimated to be 7,696 with coefficient of variation (CV) = 0.58.

Recent abundance was estimated using data collected during an autumn 1991 aerial line transect survey in the CeTAP study area (NMFS unpublished data), which included an interplatform experiment between a Twin Otter and an AT-11 aircraft, and from three fine-scale ship surveys (August 1990, June-July 1991, and June-July 1993) conducted in continental shelf edge and deeper oceanic waters (NMFS unpublished data).

The three shipboard surveys covered relatively small portions of the northeastern U.S. EEZ. The abundance estimate from the August 1990 survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank, was 2,903 bottlenose dolphins (CV = 0.66). The 1991 survey estimate, based principally on sighting effort conducted between the 200 and 2,000 meter isobaths from Cape Hatteras to Georges Bank was 5,990 bottlenose dolphins (CV = 0.39). The estimate for the 1993 survey, conducted principally between the 200 and 2,000 meter isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southwestern edge of the Scotian Shelf was 716 bottlenose dolphins (CV = 0.44). Although the 1990-1993 surveys did not sample the same areas or encompass the entire bottlenose dolphin habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-93 data suggest that, seasonally, at least several thousand bottlenose dolphins are occupying these waters; however, survey coverage to date is not judged adequate to provide a definitive estimate of bottlenose dolphin abundance in the western North Atlantic because of the limited scope of the shipboard surveys.

The 1991 aerial survey sightings during both the AT-11 and Twin Otter surveys were almost exclusively in the continental shelf edge waters. Data from both survey platforms was used in estimating stock size because the independent abundance estimates were not significantly different and coverage of continental shelf edge waters by both platforms was similar. The sighting data were analyzed using standard line transect perpendicular sighting distance analysis methods (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993). Bottlenose dolphin abundance was not significantly different between survey platforms and was estimated at 12,760 dolphins (CV = 0.84) from the AT-11 aircraft and 12,090 dolphins (CV = 0.38) from the Twin Otter aircraft. The inverse variance-weighted mean of these independent abundance estimates was used in calculating the minimum population estimate and was 12,194 bottlenose dolphins (CV = 0.35) (NMFS unpublished data).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed mean abundance estimate of 12,194 bottlenose dolphins (CV = 0.35) from the 1991 aerial surveys (NMFS unpublished data). This is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994). The minimum population estimate is 9,195 bottlenose dolphins.

Current Population Trend

The data are insufficient to determine population trends. The recent aerial survey estimates are not comparable to the CeTAP estimates because the recent data are from a single survey conducted during August-October while the CeTAP estimates were based on data pooled over several years of seasonal surveys.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) has been 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 size (OSP). In accordance with the guidelines for estimating PBR, the recovery factor was 0.50 because of the stock's unknown status relative to OSP and because the coefficient of variation of the estimated fishery-related mortality and serious injury was less than 0.30. PBR for the mid-Atlantic offshore bottlenose dolphin stock is 92 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no available estimates of human-caused mortality or serious injury except for estimates extrapolated from data obtained through NMFS fishery observer programs.

Estimated average annual fishery-related mortality or serious injury to this stock is 128 offshore bottlenose dolphins (CV = 0.39). This level is not less than 10% of the calculated PBR and, therefore, cannot be considered to be 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

There was no documentation of marine mammal mortality or serious injury in distant-water fleet (DWF) activities off the northeast coast of the U.S. prior to 1977. A fisheries observer program which has recorded fishery data and information on incidental by-catch of marine mammals was established with implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA) in 1977. DWF effort in the U.S. Atlantic EEZ under MFCMA was directed primarily towards Atlantic mackerel and squid. An average of 120 different foreign vessels per year (range 102-161) operated within the Atlantic coast EEZ from 1977 through 1982. In 1982, the first year that the NMFS Northeast Regional Observer Program assumed responsibility for observer coverage of the longline vessels, there were 112 different foreign vessels, eighteen (16%) of which were Japanese tuna longline vessels operating along the U.S. east coast. Between 1983 and 1991, the number of foreign fishing vessels operating within the U.S. Atlantic EEZ each year declined from 67 to nine. Between 1983 and 1988, the numbers of DWF vessels included 3, 5, 7, 6, 8, and 8, respectively, Japanese longline vessels. Observer coverage on DWF vessels was 25-35% during 1977-82, and increased to 58%, 86%, 95%, and 98%, respectively, in 1983-86. From 1987-91, 100% observer coverage was maintained. Foreign fishing operations for squid ceased at the end of the 1986 fishing season and for mackerel at the end of the 1991 season. Observers in this program recorded nine bottlenose dolphin mortalities in foreign-fishing activities during 1977-1988 (Waring et al. 1990). Seven takes occurred in the mackerel fishery, and one bottlenose dolphin each was caught in both the squid and hake trawl fisheries.

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook 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). SEFSC also provides observer coverage of vessels fishing south of Cape Hatteras. The Atlantic longline fisheries target primarily swordfish and yellowfin tuna from the Grand Banks south into the Caribbean and the Gulf of Mexico. There have been no reported lethal takes of this stock by the longline fishery recently, but one bottlenose dolphin was taken and released alive by the fishery during 1993 in offshore waters outside of the U.S. EEZ (NMFS unpublished data).

The estimated total number of hauls in the Atlantic large 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). Thirty-nine bottlenose dolphin mortalities have been observed between 1989 and 1993. Estimated bottlenose dolphin kills (CV in parentheses) extrapolated for each year were 72 in 1989 (0.59), 115 in 1990 (0.42), 26 in 1991 (0.44), 28 in 1992 (0.21), and 22 in 1993 (0.25). Mean annual estimated fishery-related mortality for this fishery in 1989-1993 was 53 bottlenose dolphins (CV = 0.56).

Atlantic swordfish/tuna/shark pair trawl fishery effort has increased from none in 1989 and 1990, to an estimated 171 hauls in 1991, and then to an estimated 989 and 1,087 hauls in 1992 and 1993, respectively. The fishery operated in August-November in 1991, June-November in 1992, and June-October in 1993. Sea sampling began in October of 1992 when 101 hauls (10% of the total) were sampled. In 1993, 201 hauls (18%) were sampled. Nineteen vessels have operated in this fishery. The fishery extends from 35°N to 41°N, and from 69°W to 72°W. Approximately 50% of the total effort was within a one degree square at 39°N, 72°W, around Hudson Canyon. Fishery locations and species composition of the by-catch showed little seasonal change during the six months of operation and did not warrant stratification of observer effort. Twenty-one bottlenose dolphin mortalities were observed between 1991 and 1993. Estimated annual fishery-related mortality (CV in parentheses) was 13 dolphins in 1991 (0.53), 73 in 1992 (0.49), and 85 in 1993 (0.41). The estimated mean annual bottlenose dolphin mortality attributable to this fishery is 57 (CV = 0.51).

Vessels in the New England groundfish multispecies trawl fishery, a Category III fishery under the MMPA, were observed in order to meet fishery management needs, rather than marine mammal management needs. An average of 970 (CV = 0.04) vessels (full and part time) participated annually in the fishery during 1989-1993. The fishery is active in New England waters in all seasons. One bottlenose dolphin mortality was documented in 1991 and the total estimated mortality in this fishery in 1991 was 91 (CV = 0.97). The average fishery-related mortality attributable to this fishery between 1989-1993 was 18 bottlenose dolphins (CV = 2.17).

The mid-Atlantic mackerel and squid trawl fisheries were combined into the Atlantic mid-water trawl fishery in the revised proposed list of fisheries in 1995. The fishery occurs along the U.S. mid-Atlantic continental shelf region between New Brunswick, Canada, and Cape Hatteras year around. The mackerel trawl fishery was classified as a Category II fishery since 1990 and the squid fishery was originally classified as a Category II fishery in 1990, but was reclassified as a Category III fishery in 1992. The combined fishery has been proposed for classification as a Category II fishery. Although there were reports of bottlenose dolphin mortalities in the foreign fishery during 1977-1988, there were no fishery-related mortalities of bottlenose dolphins reported in logbook reports from the mackerel trawl fishery between 1990-1992.

Other Mortality

There are no other known sources of human-caused mortality affecting this stock.

STATUS OF STOCK

The status of this stock relative to OSP is unknown. The western north Atlantic offshore bottlenose dolphin is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. This stock is a strategic stock because estimated annual fishery-related mortality and serious injury exceeds PBR.

REFERENCES

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.

Buckland, S. T., D. R. Andersen, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman and Hall, New York, 446 pp.

CeTAP (Cetacean and Turtle Assessment Program). 1982. "A Characterization of Marine Mammals and Turtles in the Mid- and North Atlantic Areas of the U.S. Outer Continental Shelf, Final Report", Contract AA551-CT8-48, U.S. NTIS PB83-215855, Bureau of Land Management, Washington, DC, 576 pp.

Duffield, D. A. 1986. Investigation of genetic variability in stocks of the bottlenose dolphin (*Tursiops truncatus*). Final report to the NMFS/SEFC, Contract No. NA83-GA-00036, 53 pp.

Duffield, D. A., Ridgway, S. H., and Cornell, L. H. 1983. Hematology distinguishes coastal and offshore forms of dolphins (*Tursiops*). Can. J. Zool. 61: 930-933.

Hersh, S. L. and D. A. Duffield. 1990. Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. Pages 129-139 *in* S. Leatherwood and R. R. Reeves (editors), The bottlenose dolphin, Academic Press, San Diego, 653 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Kenney, R. D. 1990. Bottlenose dolphins off the northeastern United States. Pages 369-386 *in* S. Leatherwood and R. R. Reeves (editors), The bottlenose dolphin, Academic Press, San Diego, 653 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.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement. June 1991.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

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.

BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Western North Atlantic Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two hematologically and morphologically distinct bottlenose dolphin ecotypes (Duffield et al. 1983; Duffield 1986) which correspond to a shallow, warm water ecotype and a deep, cold water ecotype; both ecotypes have been shown to inhabit waters in the western North Atlantic Ocean (Hersh and Duffield 1990). Bottlenose dolphins which had stranded alive in the western North Atlantic in areas with direct access to deep oceanic waters had hemoglobin profiles matching that of the deep, cold water ecotype (Hersh and Duffield 1990). Hersh and Duffield (1990) also described morphological differences between the deep, cold water ecotype dolphins and dolphins with hematological profiles matching the shallow, warm water ecotype which had stranded in the Indian/Banana River in Florida. Because of their occurrence in shallow, relatively warm waters along the U.S. Atlantic coast and because their morphological characteristics are similar to the shallow, warm water ecotype described by Hersh and Duffield (1990), the Atlantic coastal bottlenose dolphin stock is believed to consist of this ecotype. There are currently insufficient data to allow separation of locally resident bottlenose dolphins (such as those from the Indian/Banana River) from the coastal stock in the western North Atlantic.

The structure of the coastal bottlenose dolphin stock in the western North Atlantic is uncertain, but what is known about it suggests that the structure is complex. A portion of the coastal stock migrates north of Cape Hatteras, North Carolina, to New Jersey during the summer (Scott et al. 1988). It has been suggested that this stock is restricted to waters < 25 m in depth within the northern portion of its range (Kenney 1990) because of an apparent disjunct distribution of bottlenose dolphins centered on the 25 m isobath which was observed during surveys of the region (CeTAP 1980). The lowest density of bottlenose dolphins was observed over the continental shelf, with higher densities along the coast and near the continental shelf edge. The coastal stock is believed to reside south of Cape Hatteras in the late winter (Mead 1975; Kenney 1990); however, the depth distribution of the stock south of Cape Hatteras is uncertain and the coastal and offshore stocks may overlap there. There was no apparent longitudinal discontinuity in bottlenose dolphin herd sightings during aerial surveys south of Cape Hatteras in the winter (Blaylock and Hoggard 1994).

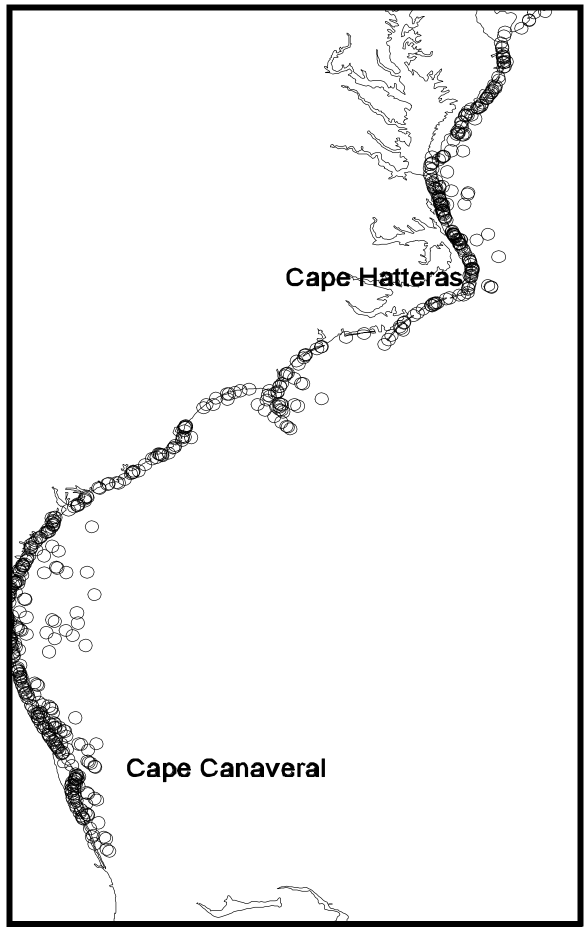


Figure 1. *Sightings of bottlenose dolphins during aerial surveys to the 25 m isobath north of Cape Hatteras during summer 1994, 9 km past the eastern Gulf Stream wall south of Cape Hatteras during winter 1991, and three coastal surveys within one km of shore from New Jersey to mid-Florida during the summer in 1994.*

Scott et al. (1988) hypothesized a single coastal migratory stock ranging seasonally from as far north as Long Island, NY, to as far south as central Florida, citing stranding patterns during a high mortality event in 1987-88 and observed density patterns along the U.S. Atlantic coast. Figure 1 illustrates the distribution of 584 bottlenose dolphin herd sightings during aerial surveys from shore to approximately 9 km past the Gulf Stream edge south of Cape Hatteras in the winter in 1992 (Blaylock and Hoggard 1994), from shore seaward to the 25 m isobath during the summer north of Cape Hatteras in 1994 (Blaylock 1995), and within one km of the shore from New Jersey to mid-Florida during three coastal surveys conducted during the summer in 1994 (Blaylock 1995). The proportion of the sightings illustrated which might be of bottlenose dolphins from other than the coastal stock is unknown; however, it is reasonable to assume that the coastal surveys within one km of shore minimized inclusion of the offshore stock.

A working hypothesis for the coastal bottlenose dolphin stock structure postulates that there are local, resident stocks in certain embayments and that transient stocks migrate seasonally into and out of these embayments (Scott et al. 1988). In the Indian-Banana River, 28 of 36 marked bottlenose dolphins either resided in or returned to the river system for a period of at least ten years (Odell and Asper 1990). Eight of the marked dolphins were never positively resighted. None of the marked dolphins were reported from outside the river system; however, search outside of the river system was limited. If the working hypothesis is correct, exchange between resident and transient components of the coastal stock could be sufficient to mask any genetic indicators of stock distinction, even though the stock components might be sufficiently distinct to respond differently to population pressures.

POPULATION SIZE

Mitchell (1975) estimated that the coastal bottlenose dolphin population which was exploited by a shore-based net fishery until 1925 (Mead 1975) was at least 13,748 bottlenose dolphins in the 1800s. Recent estimates of bottlenose dolphin abundance in the U.S. Atlantic coastal area were made from two types of aerial surveys. The first type was aerial survey using standard line transect sampling with perpendicular distance data analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993). The alternate survey method consisted of a simple count of all bottlenose dolphins seen from aerial surveys within one km of shore.

An aerial line-transect survey conducted during February-March 1991 in the coastal area south of Cape Hatteras. Sampling transects extended orthogonally from shore out to approximately 9 km past the western wall of the Gulf Stream into waters as deep as 140 m, and the area surveyed extended from Cape Hatteras to mid-Florida (Blaylock and Hoggard 1994). Systematic transects were placed randomly with respect to bottlenose dolphin distribution and approximately 3.3% of the total survey area of approximately 89,900 km^2 was visually searched. Survey transects, area, and dates were chosen utilizing the known winter distribution of the stocks in order to sample the entire coastal population; however, the offshore stock may represent some unknown proportion of the resulting population size estimates. Preliminary estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to the perpendicular distance sighting data. Bottlenose dolphin abundance was estimated to be 12,435 dolphins with coefficient of variation (CV) = 0.18 and the log-normal 95% confidence interval was 9,684-15,967 (Blaylock and Hoggard 1994).

Perpendicular sighting distance analysis (Buckland et al. 1983) of line transect data from an aerial survey throughout the northern portion of the range in July 1994, from Cape Hatteras to Sandy Hook, New Jersey, and from shore to the 25 m isobath, resulted in an abundance estimate of 25,841 bottlenose dolphins (CV = 0.40) (Blaylock 1995) within the approximately 25,600 km^2 area. These data were collected during a pilot study for designing future surveys and are considered to be preliminary in nature.

Either of the aerial line transect surveys and the resulting abundance estimates may have included dolphins from the offshore stock. It is not currently possible to distinguish the two bottlenose dolphin ecotypes during visual aerial surveys and the distribution of the two ecotypes in U.S. Atlantic EEZ waters is uncertain. Additional research is needed to interpret the significance of the line transect survey results.

An aerial survey of the coastal waters within a one km strip along the shore from Sandy Hook to approximately Vero Beach, Florida, was also conducted during July 1994 (Blaylock 1995). Dolphins from the offshore stock are believed unlikely to occur in this area. Observers counted all bottlenose dolphins seen within the one km strip alongshore from Cape Hatteras to Sandy Hook (northern area) and within the one km strip alongshore south of Cape Hatteras to approximately Vero Beach (southern area). The average of three counts of bottlenose dolphins in the northern area was 927 dolphins (range = 303-1,667) and the average of three counts of bottlenose dolphins in the southern area was 630 dolphins (range = 497-815). The sum of the highest counts in both areas was 2,482 dolphins.

Minimum Population Estimate

Reasonable assurance of a minimum population estimate was not provided by line transect surveys because the proportion of dolphins from the offshore stock which might have been observed is unknown. The minimum population size was therefore taken as the highest count of bottlenose dolphins within the one km strip from shore between Sandy Hook and Vero Beach obtained during the July 1994 survey. The maximum count within one km of shore between Sandy Hook and Cape Hatteras was 1,667 bottlenose dolphins and it was 815 bottlenose dolphins within one km of shore between Cape Hatteras and Vero Beach. The resulting minimum population size estimate for the western North Atlantic coastal bottlenose dolphin stock is 2,482 dolphins.

Current Population Trend

Kenney (1990) reported an estimated 400-700 bottlenose dolphins from the inshore strata of aerial surveys conducted along the U.S. Atlantic coast north of Cape Hatteras in the summer during 1979-1981. These estimates resulted from line transect analyses; thus, they cannot be used in comparison with the direct count data collected in 1994 to assess population trends.

There was no significant difference in bottlenose dolphin abundance estimated from aerial line transect surveys conducted south of Cape Hatteras in the winter of 1983 and the winter of 1991 using comparable survey designs (NMFS unpublished data; Blaylock and Hoggard 1994) in spite of the 1987-88 mortality incident during which it was estimated that the coastal migratory population may have been reduced by up to 53% (Scott et al. 1988).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) has been specified as the product of the 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 size (OSP) (Anon. 1994). The recovery factor was set at 0.50 because of the stock is listed as depleted under the Marine Mammal Protection Act. PBR for the U.S. Atlantic coastal bottlenose dolphin stock is 25 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Four bottlenose dolphins were reported by the Northeast Region Stranding network to have shown signs of entanglement with fishing gear in Virginia in 1992 (K. Thounhurst, NMFS, personal communication, 1994). One of these was associated with pound net gear. In 1993, eight bottlenose dolphins in Virginia and one in Maryland were reported as entangled in fishing gear, but the gear type was not reported (NMFS unpublished data). Signs of interaction with fisheries (entanglement, net marks, missing appendages) were present in 22% of the bottlenose dolphin strandings investigated in North Carolina in 1993 (NMFS unpublished data).

The percentage of total mortality represented by stranded dolphins is unknown, but 20 bottlenose dolphin mortalities which showed signs of fishery interaction were reported in the Atlantic states of the NMFS Southeast Region in 1993 (NMFS unpublished data). A total of 29 bottlenose dolphins from the U.S. Atlantic coastal stock in the combined 1993 stranding records from both of the NMFS regions were reported to have shown indications of some sort of fishery interaction (NMFS unpublished data). It is unclear whether the interactions contributed to the mortalities or occurred post-mortem. Examination of marine mammal stranding records from the NMFS Southeast Region collected during 1988-1993 showed that an average of 21 (CV = 0.30) stranded bottlenose dolphins from the area including North Carolina to the Florida Keys were discovered annually showing signs of human interaction ranging from net marks and entanglement to gunshot wounds and boat propeller strikes (Southeast U.S. Marine Mammal Stranding Network unpublished data).

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Another factor complicating the estimation of fishery-related mortality and serious injury to this stock using stranding data is the fact that an unknown proportion of stranded dolphins are from the offshore stock. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

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 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

Menhaden purse seiners have reported an annual incidental take of one to five bottlenose dolphins (NMFS 1991, pp. 5-73). Observer data are not available. The Atlantic menhaden purse seine fishery targets the Atlantic menhaden, *Brevortia tyrannus*, in Atlantic coastal waters approximately 3-18 m in depth. Twenty-two vessels operate off northern Florida to New England from April-January (NMFS 1991, pp. 5-73).

Coastal gillnets operate in different seasons targeting different species in different states throughout the range of this stock. Most nets are staked close to shore, but some are allowed to drift, and nets range in length from 91 m to 914 m. A gillnet fishery for American shad, *Alosa sapidissima*, operates seasonally from Connecticut to Georgia, with nets being moved from coastal ocean waters into fresh water with the shad spawning migration (Read 1994). There has been no direct observation by NMFS of this particular fishery, which is conducted in state waters, but it is considered likely that a few bottlenose dolphins are taken in this fishery each year (Read 1994). The North Carolina sink gillnet fishery operates in October-May targeting weakfish, croaker, spot, bluefish, and dogfish. Another gillnet fishery along the North Carolina Outer Banks targets bluefish in January-March. Similar mixed-species gillnet fisheries, under state jurisdiction, operate seasonally along the coast from Florida to New Jersey, with the exclusion of Georgia. There are no estimates of bottlenose dolphin mortality or serious injury available for these fisheries. A rough estimate of the average total annual coastal gillnet fishing effort is given in Table I.

Observer coverage of the U.S. Atlantic coastal gillnet fishery was initiated by the NEFSC Sea Sampling program in July, 1993; and from July to December 1993, 20 trips were observed. From January to April 1994, 71 trips were observed. 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, some of which operate right off the beach. The number of vessels in this fishery is unknown, because records are held by both state and federal agencies, and have not, as of yet, been centralized and standardized. Percent coverage by the program is unknown, but it is believed to be very low. No bottlenose dolphins were taken in the observed trips.

The shrimp trawl fishery operates from North Carolina through northern Florida virtually year around, moving seasonally up and down the coast. Estimated total fishing effort is given in Table I. One bottlenose dolphin was recovered dead from a shrimp trawl in Georgia in 1995 (Southeast U.S. Marine Mammal Stranding Network unpublished data), but no bottlenose dolphin mortality or serious injury has been previously reported to NMFS.

A haul seine fishery operates along northern North Carolina beaches during the spring and fall targeting mullet, spot, sea trout, and bluefish. There has been no by-catch of marine mammals reported to NMFS.

Table I. *Roughly estimated average annual fishing effort (number deployed) by gear type for U.S. Atlantic coastal fisheries from New Jersey to Key West, Florida, in 1992-1993, having the potential for causing serious injury or mortality to bottlenose dolphins (NMFS unpublished data).*

Gear Type	Effort
Haul seines	222
Purse seines	11,962
Otter trawls, bottom	22,550
Otter trawls, midwater	70
Gillnets, anchored or staked	22,252
Gillnets, drift and runaround	11,792

Other Mortality

The nearshore habitat occupied by this stock is adjacent to areas of high human population and in the northern portion of its range is highly industrialized. The blubber of stranded dolphins examined during the 1987-88 mortality event contained anthropogenic contaminants in levels among the highest recorded for a cetacean (Geraci 1989). There are no estimates of indirect human-caused mortality resulting from pollution or habitat degradation, but a recent assessment of the health of live-captured bottlenose dolphins from Matagorda Bay, Texas, associated high levels of certain chlorinated hydrocarbons with low health assessment scores (Reif et al., in preparation).

STATUS OF STOCK

This stock is considered to be depleted relative to OSP and it is listed as depleted under the Marine Mammal Protection Act (MMPA). There are data suggesting that the population was at an historically high level immediately prior to the 1987-88 mortality event (Keinath and Musick 1988); however, the 1987-88 anomalous mortality event was estimated to have decreased the population by as much as 53% (Scott et al. 1988). A comparison of historical and recent winter aerial survey data in the area south of Cape Hatteras found no statistically significant difference between population size estimates (Student's t-test, P > 0.10), but these estimates may have included an unknown proportion of the offshore stock Population trends cannot be determined due to insufficient data.

There are no observer data directly linking serious injury and mortality to fisheries, but the total number of bottlenose dolphins assumed from this stock which stranded showing signs of fishery or human-related mortality exceeded PBR in 1993.

The species is not listed as threatened or endangered under the Endangered Species Act, but because this stock is listed as depleted under the MMPA it is a strategic stock.

REFERENCES

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.

Blaylock, R. A. 1995. A pilot study to estimate abundance of the U.S. Atlantic coastal migratory bottlenose dolphin stock. NOAA Tech. Mem. NMFS-SEFSC-362, 9 pp.

Blaylock, R. A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Mem. NMFS-SEFSC-356, 10 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

CeTAP (Cetacean and Turtle Assessment Program). 1982. "A Characterization of Marine Mammals and Turtles in the Mid- and North Atlantic Areas of the U.S. Outer Continental Shelf, Final Report", Contract AA551-CT8-48, U.S. NTIS PB83-215855, Bureau of Land Management, Washington, DC, 576 pp.

Duffield, D. A. 1986. Investigation of genetic variability in stocks of the bottlenose dolphin (*Tursiops truncatus*). Final report to the NMFS/SEFC, Contract No. NA83-GA-00036, 53 pp.

Duffield, D. A., Ridgway, S. H., and Cornell, L. H. 1983. Hematology distinguishes coastal and offshore forms of dolphins (*Tursiops*). Can. J. Zool. 61: 930-933.

Geraci, J. R. 1989. Clinical investigation of the 1987-88 mass mortality of bottlenose dolphins along the U.S. central and south Atlantic coast. Final Report to National Marine Fisheries Service, U.S. Navy, Office of Naval Research, and Marine Mammal Commission, 63 pp.

Hersh, S. L. and D. A. Duffield. 1990. Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. Pages 129-139 *in* S. Leatherwood and R. R. Reeves (editors), The bottlenose dolphin, Academic Press, San Diego, 653 pp.

Keinath, J. A. and J. A. Musick. 1988. Population trends of the bottlenose dolphin (*Tursiops truncatus*) in Virginia. Final Contract Report, Contract No. 40-GENF-800564, Southeast Fisheries Science Center, Miami, FL, 36 pp.

Kenney, R. D. 1990. Bottlenose dolphins off the northeastern United States. Pages 369-386 *in* S. Leatherwood and R. R. Reeves (editors), The bottlenose dolphin, Academic Press, San Diego, 653 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user’s guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Mead, J. G. 1975. Preliminary report on the former net fisheries for *Tursiops truncatus* in the western North Atlantic. J. Fish. Res. Bd. Can. 32(7): 1155-1162.

Mitchell, E. 1975. Porpoise, dolphin and small whale fisheries of the world. Status and problems. Int. Union Conserv. Natur. Resour. Monogr. 3: 1-129.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement, June 1991.

Odell, D. K. and E. D. Asper. 1990. Distribution and movements of freeze-branded bottlenose dolphins in the Indian and Banana Rivers, Florida. Pages 515-540 *in* S. Leatherwood and R. R. Reeves (editors), The bottlenose dolphin, Academic Press, San Diego, 653 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.

Reif, J. S., L. J. Hansen, S. Galloway, G. Mitchum, T. L. Schmitt. In preparation. The relationship between chlorinated hydrocarbon contaminants and selected health parameters in bottlenose dolphins (*Tursiops truncatus*) from Matagorda Bay, Texas, 1992. Colorado State University, Fort Collins, and NMFS, Southeast Fisheries Science Center, Miami, Florida.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

Scott, G. P., D. M. Burn, and L. J. Hansen. 1988. The dolphin dieoff: long term effects and recovery of the population. Proceedings: Oceans '88, IEEE Cat. No. 88-CH2585-8,Vol. 3: 819-823.

HARBOR PORPOISE (*Phocoena phocoena)*:
Gulf of Maine/Bay of Fundy Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

This stock is found in U.S. and Canadian Atlantic waters. During the summer (July to September), harbor porpoises are concentrated in the northern Gulf of Maine and southern Bay of Fundy region, generally in waters less than 150 m deep (Gaskin 1977; Kraus et al. 1983; Palka 1994a). During fall (October-December) and spring (April-June), harbor porpoises are widely dispersed from North Carolina to Maine, and harbor porpoise density is much lower than during the summer. No specific migratory routes to the northern Gulf of Maine/lower Bay of Fundy region have been documented. Harbor porpoises are seen from near the coastline into the middle of the Gulf of Maine (>200 m deep) in both spring and fall. There is little information about the distribution of harbor porpoise during winter (December to March), although numerous strandings have occurred on beaches from North Carolina to New York. There are two stranding records from Florida (Smithsonian strandings data base).

Gaskin (1984, 1992) proposed that there were four separate populations in the western North Atlantic, these being the Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland and Greenland populations. Presently there is insufficient evidence to accept or reject this hypothesis. Results of a workshop held in February, 1994 were inconclusive with respect to population structure of harbor porpoises in the western North Atlantic, although it was agreed upon that animals found in the Gulf of Maine and Bay of Fundy are from the same stock (Palka 1994b). Research is currently being conducted to re-analyze existing genetic data and analyze new samples in order to resolve the larger scale stock structure question. This report follows Gaskin's hypothesis on harbor porpoise stock structure in the western North Atlantic; Gulf of Maine and Bay of Fundy harbor porpoises are recognized as a single management stock separate from harbor porpoise populations in the Gulf of St. Lawrence, Newfoundland, and Greenland.

POPULATION SIZE

Two line-transect sighting surveys were conducted — one in 1991, the other in 1992 — to estimate the absolute population size of the harbor porpoises aggregated in the Gulf of Maine/Bay of Fundy region during the summer. The study area was stratified by water depth and expected density of harbor porpoises. Harbor porpoise sightings are shown in Figure 1.

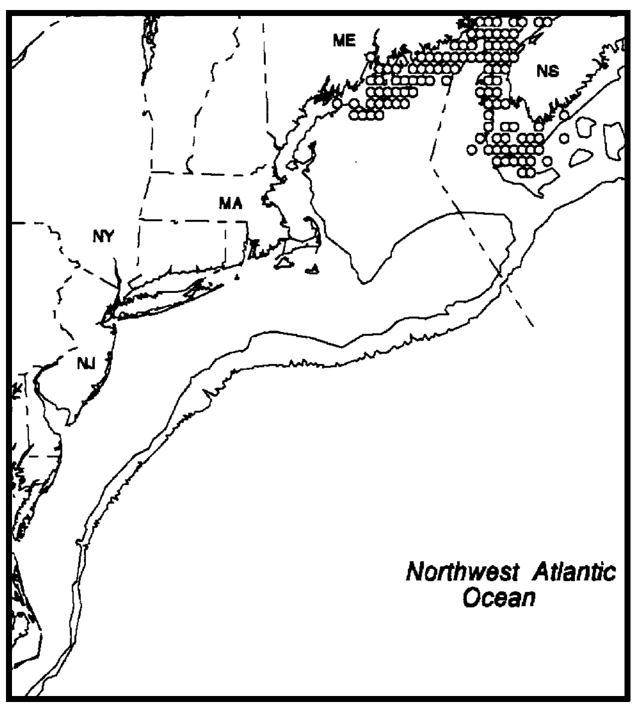


Figure 1. *Distribution of harbor porpoise sightings from NEFSC shipboard surveys during the summer in 1991-1992. Isobaths are at 100 m and 1,000 m.*

The shipboard sighting survey procedure to estimate abundance corrected for g(0) used two independent teams that searched using the naked eye in non-closing mode. Abundance, corrected for g(0), was estimated using the direct-duplicate method (Palka, in press) and variability was estimated using bootstrap re-sampling methods. The abundance estimates were 37,500 harbor porpoises in 1991 [coefficient of variation (CV) = 0.29, 95% confidence interval (CI) = 26,700-86,400] and 67,500 harbor porpoises in 1992 (CV = 0.23, 95% CI = 32,900-104,600). The inverse variance weighted-average estimate (Smith et al. 1993) of harbor porpoise abundance was 47,200 harbor porpoises (CV = 0.19, 95% CI = 39,500-70,600). Possible reasons for the inter-annual abundance and distribution differences include inter-annual changes in water temperature and availability of primary prey species (Palka 1994a).

Potential biases that have not been explicitly accounted for in the present abundance estimates are ship avoidance, time of submergence, and potential recounting of animals. Preliminary analyses indicate that ship avoidance, though present to some degree, did not substantially affect the abundance estimate (NEFSC 1992).

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 47,200 harbor porpoises (CV = 0.19) (Palka, in press). This is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994). The minimum population estimate is 40,297 harbor porpoises.

Current Population Trend

There are insufficient data to determine the population trends for this species. Previous abundance estimates for harbor porpoises in the Gulf of Maine/Bay of Fundy are available from earlier studies, (e. g. 4,000 animals, Gaskin 1977, and 15,800 animals, Kraus et al. 1983). These estimates cannot be used in a trends analysis because they were for selected small regions within the entire known summer range and, in some cases, did not incorporate any estimate of g(0) (NEFSC 1992).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Although current population growth rates of western North Atlantic harbor porpoises have not been estimated due to lack of data, several attempts have been made to estimate potential population growth rates. Barlow and Boveng (1991), who used a re-scaled human life table, estimated the upper bound of the annual potential growth rate to be 9.4%. Woodley and Read (1991) used a re-scaled Himalayan tahr life table to estimate the likely annual growth rate to be 4%. In an attempt to estimate the potential population growth rate which incorporated many of the uncertainties in survivorship and reproduction, Caswell et al. (1994) used a Monte Carlo method to calculate a distribution of growth rates, which indicated that the potential growth rate is unlikely to be greater than 10% per year. The median of this distribution is approximately 4%, but, it is not known whether this is the best estimate (Palka 1994b). Therefore, the maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 0.50 because of the stock's status relative to its OSP level is unknown. PBR for this stock is 403 harbor porpoises.

ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality and serious injury to this stock in the Atlantic during 1989-1993 was 1,876 harbor porpoises (CV = 0.32). This is probably an underestimate because it does not include fishery-related mortality and serious injury in Canadian fisheries, nor does it include mortality associated with the U.S. Atlantic coastal gillnet fishery. Average annual fishery-related mortality and serious injury may actually be more on the order of 2,100-2,350 harbor porpoises per year. Total annual 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 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 Canadian gillnet fishery occurs mostly in the western portion of the Bay of Fundy during the summer and early autumn months, when the density of harbor porpoises is highest there. This fishery has been well-documented, with 19 gillnetters active in 1986, 28 active in 1987, and 21 in 1988 (Polacheck 1989). Canadian total harbor porpoise by-catch in this fishery was thought to be low, based on casual observations and discussions with fishermen. The 1986 estimated harbor porpoise by-catch was 94-116 and estimated by-catch was 130 harbor porpoises in 1989 (O'Boyle and Zwanenburg 1994).

An observer program implemented in the Canadian Bay of Fundy sink gillnet fishery during the summer of 1993 provided total by-catch estimates of between 222-424 harbor porpoises (O'Boyle and Zwanenburg 1994). No measure of variability was estimated. This program was expanded in 1994 and the 1994 by-catch was estimated to be between 80-120 harbor porpoises (DFO 1995).

Some harbor porpoises are caught in Canadian and U.S. weirs in a fishery which occurs from May to September each year. Weirs are found along the southwestern shore of the Bay of Fundy, and scattered along the western Nova Scotia and northern Maine coasts. There were 180 active weirs in the western Bay of Fundy and 56 active weirs in Maine in 1990 (Read 1994). Smith et al. (1983) estimated that approximately 70 harbor porpoises become trapped annually and, on average, 27 harbor porpoises die annually in Bay of Fundy weirs; the rest are released alive. At least 43 harbor porpoises were trapped in Bay of Fundy weirs in 1990, but the number killed is unknown. In 1993, after a cooperative program between fishermen and Canadian biologists began, over 100 harbor porpoises were released alive and an unknown number died (Read 1994).

There is evidence that harbor porpoises were harvested by natives in Maine and Canada before the 1960's, and the meat was used for human consumption, oil, and fish bait (NEFSC 1992). The extent of these past harvests is unknown, though it is believed to be small. Up until the early 1980s, small kills by native hunters (Passamaquoddy Indians) were reported. However, in recent years it is believed to have nearly stopped (Polacheck 1989).

A sampling program was conducted to collect information concerning marine mammal by-catch in the New England groundfish gillnet fishery in 1984. Approximately 10% of the vessels fishing in Maine, New Hampshire, and Massachusetts were sampled. Among the eleven gillnetters who received permits and logbooks, 30 harbor porpoises were reported caught. It was estimated, using rough estimates of fishing effort, that a maximum of 600 harbor porpoises were killed annually in this fishery (Gilbert and Wynne 1985, 1987).

Data on incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries. 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 provides observer coverage of vessels fishing south of Cape Hatteras.

By-catch has been observed by NMFS Sea Samplers in the New England multispecies gillnet, Atlantic swordfish/tuna/shark gillnet, and New England groundfish trawl fisheries; but no mortalities were documented in the Atlantic swordfish/tuna/shark longline, and Atlantic swordfish/tuna/shark pair trawl fisheries.

There were approximately 349 full and part-time vessels in the New England multispecies sink gillnet fishery, which covers the Gulf of Maine and southern New England, in 1993. An additional 187 vessels were reported to occasionally fish in the Gulf of Maine with gillnets for bait or personal use; however, these vessels were not covered by the observer program (Walden, in review) and their fishing effort was not used in estimating mortality. Observer coverage in terms of trips has been 1%, 6%, 7. 5%, and 5% for years 1990 to 1993, respectively. There were 220 harbor porpoise mortalities related to this fishery observed between 1990 and 1993 and one was released alive uninjured. Annual estimates of harbor porpoise by-catch in the New England multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Estimated annual by-catch (CV in parentheses) from this fishery during 1990-1993 was 2,900 in 1990 (0.32), 2,000 in 1991 (0.35), 1,200 in 1992 (0.21), and 1,400 in 1993 (0.18) (Bravington and Bisack, in review; CUD 1994); average estimated harbor porpoise mortality and serious injury in the New England multispecies sink gillnet fishery during 1989-1993 was 1,875 (0.32). These estimates include a correction factor for the under-recorded number of by-caught animals that occurred during unobserved hauls on trips with observers on the boat, when applicable. Need for such a correction became evident following re-analysis of data from the sea sampling program indicating that for some years by-catch rates from unobserved hauls were lower than that for observed hauls. Further analytical details are given in Palka (1994b) and CUD (1994). These revised by-catch estimates replace those published earlier (Smith et al. 1993). These estimates are still negatively biased because they do not include porpoises that fell out of the net while still underwater. This bias cannot be quantified at this time. By-catch in the northern Gulf of Maine occurs primarily from June to September; while in the southern Gulf of Maine by-catch occurs from January to May and September to December.

There is no evidence of differential mortality in U.S. or Canadian gillnet fisheries by age or sex, although there is substantial inter-annual variation in the age and sex composition of the by-catch (Read and Hohn, in review).

Pinger experiments, using acoustic alarms attached to some observed gillnets, were conducted in the Gulf of Maine in 1992, 1993, and 1994. All trips were observed for all vessels involved in these experiments, whether or not the nets had alarms attached. There were 12, 33, and 29 harbor porpoise mortalities observed during 1992, 1993, and 1994, respectively, from these trips. These mortalities were included estimating annual mortality.

Observer coverage of the U.S. Atlantic coastal gillnet fishery was initiated by the NEFSC Sea Sampling program in July, 1993; and from July to December 1993, 20 trips were observed. From January to April 1994, 71 trips were observed. 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, some of which operate right off the beach. The number of vessels in this fishery is unknown, because records which are held by both state and federal agencies have not been centralized and standardized. Percent coverage by the program is unknown, but it is believed to be very low. No harbor porpoises were taken in these observed trips. This result was not unexpected for July through December because there is little evidence that harbor porpoises are in the this area during this time frame; however, this is not the case for January to April. The absence of observed takes in early 1994 may reflect low observer coverage or its distribution since, harbor porpoise strandings seem to be very localized with respect to time and area, and localities also change from year to year. Polacheck et al. (in press) reported one incidental take in shad nets in the York River, Virginia. In general, strandings along U.S. Atlantic beaches suggest that harbor porpoises are taken in the Virginia shad fishery and other coastal gillnet fisheries (Read 1994).

Vessels in the New England groundfish multispecies trawl fishery, a Category III fishery under the MMPA, were observed in order to meet fishery management needs, rather than marine mammal management needs. An average of 970 (CV = 0.04) vessels (full and part time) participated annually in the fishery during 1989-1993. This fishery is active in New England waters in all seasons. One harbor porpoise mortality was observed in this fishery between 1989 and 1993. This take occurred in February, 1992 east of Barnegatt Inlet, New York at the continental shelf break. The animal was clearly dead prior to being taken by the trawl, because it was severely decomposed and the tow duration of 3.3 hours was insufficient to allow extensive decomposition; therefore, there is no estimated by-catch for this fishery. The estimated total number of hauls in the Atlantic large pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. The estimated number of hauls in 1991, 1992, and 1993 were 233, 243, and 232, respectively. Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. 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 by-catch, for each year, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge, in review). One harbor porpoise mortality was observed between 1989 and 1993. This by-catch was notable because it occurred in continental shelf edge waters adjacent to Cape Hatteras. Estimated annual fishery-related mortality (CV in parentheses) attributable to this fishery was 0.7 in 1989 (7. 00), 1.7 in 1990 2.65), 0.7 in 1991 (2.00), 0.4 in 1992, and 1.5 in 1993 (0.45); average estimated harbor porpoise mortality and serious injury in the Atlantic large pelagic drift gillnet fishery during 1989-1993 was 1.0 (3.06).

Other Mortality

Sixty-four harbor porpoise strandings were reported from Maine to North Carolina between January and June, 1993. Fifty of those harbor porpoises were reported stranded in the U.S. Atlantic region from New York to North Carolina between February and May. Many of the carcasses recovered in this area during this time period had cuts and body damage suggestive of net marking (Haley and Read 1993). Five out of eight carcasses and fifteen heads from the strandings that were examined showed signs of human interactions (net markings on skin and missing flippers or flukes). Decomposition of the remaining animals prevented determination of the cause of death. Earlier reports of harbor porpoise entangled in gillnets in Chesapeake Bay and along the New Jersey coast and reports of apparent mutilation of harbor porpoise carcasses, raised concern that the 1993 strandings were related to a coastal net fishery, such as the American shad coastal gillnet fishery (Haley and Read 1993). Between January and May 1994, 35 harbor porpoises were found stranded along the beaches from North Carolina to New York (A. J. Read, personal communication).

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Other potential human-induced factors that may be affecting this harbor porpoise population include high levels of contaminants in their tissues and increased ship activity. Of particular concern are high levels of polychlorinated biphenyls (PCBs) and other lipophilic organochlorines in their tissues (Gaskin et al. 1983). No obvious pathology has been noted in more than 300 necropsies of harbor porpoises incidentally captured in gillnets in the Bay of Fundy (A. J. Read, unpublished data), but it is not known whether these contaminants have other effects. It has been suggested that increased shipping activity in several coastal bays has caused the disappearance of harbor porpoises in those coastal bays (NEFSC 1992).

STATUS OF STOCK

The National Marine Fisheries Service has proposed listing the Gulf of Maine harbor porpoise as threatened under the Endangered Species Act (NMFS 1993). In Canada, the Cetacean Protection Regulations of 1982, promulgated under the standing Fisheries Act, prohibit the catching or harassment of all species of cetaceans, including the harbor porpoise. There are insufficient data to determine the population trends for this species. Total annual fishery-related mortality and serious injury exceeds PBR and this is a strategic stock.

REFERENCES

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.

Barlow, J. and P. Boveng. 1991. Modeling age-specific mortality for marine mammal populations. Mar. Mam. Sci. 7:50-65.

Bravington, M. V. and K. D. Bisack. In review. Estimates of harbor porpoise by-catch in the Gulf of Maine sink gillnet fishery, 1990-1993. Submitted to Fish. Bull., U.S.

Caswell, H., S. Brault, A. Read, T. Smith, and J. Barlow. 1994. Rate of increase of harbor porpoise populations: Estimation and uncertainty. Working paper No. 10B presented at the NMFS Harbor Porpoise Workshop - February 1994. NOAA, NMFS, NEFSC, Woods Hole, Massachusetts.

CUD [Conservation and Utilization Division]. 1994. Estimating harbor porpoise by-catch in the Gulf of Maine sink gillnet fishery, NOAA, NMFS, NEFSC Ref. Doc. 94-24, Woods Hole, Massachusetts.

DFO [Canadian Department of Fisheries and Oceans]. 1995. Harbour porpoise by-catch in the Bay of Fundy gillnet fishery. Project Summary; Industry Services and Native Fisheries. No. 48, February, 1995. 4 pp.

Gaskin, D. E. 1977. Harbour porpoise, *Phocoena phocoena* (L.), in the western approaches to the Bay of Fundy 1969-75. Rep. Int. Whal. Comm 27: 487-492.

Gaskin, D. E., R. Frank, and M. Holdrinet. 1983. Polychlorinated biphenyls in harbor porpoises, *Phocoena phocoena* (L.), from the Bay of Fundy, Canada and adjacent waters, with some information on chlordane and hexachlorobenzene levels. Archives of Environmental contamination and Toxicology 12: 211-219.

Gaskin, D. E. 1984. The harbor porpoise *Phocoena phocoena* (L.): Regional populations, status, and information on direct and indirect catches. Rep. Int. Whal. Comm 34: 569-586.

Gaskin, D. E. 1992. The status of the harbour porpoise. Can. Fld. Nat. 106: 36-54.

Gilbert, J. R. and K. M. Wynne. 1985. Harbor seal populations and fisheries interactions with marine mammals in New England, 1984. Fourth Annual Report, Contract NA-80-FA-C-00029, Northeast Fisheries Center, Woods Hole, MA, 15 pp.

Gilbert, J. R. and K. M. Wynne. 1987. Harbor seal populations and fisheries interactions with marine mammals in New England. Final Report Contract NA-EA-C-0070, Northeast Fisheries Center, Woods Hole, Massachusetts. 15 pp.

Haley, N. J. and A. J. Read. 1993. Summary of the workshop on harbor porpoise mortalities and human interaction. NOAA Tech. Mem. NMFS-F/NER 5.

Kraus, S. D., J. H. Prescott, and G. S. Stone. 1983. Harbour porpoise, *Phocoena phocoena*, in the U.S. coastal waters of the Gulf of Maine: A survey to determine seasonal distribution and abundance. Report to the Director, National Marine Fisheries Service, Northeast Region, Woods Hole, Massachusetts, 15 pp.

NEFSC [Northeast Fisheries Science Center]. 1992. Harbor porpoise in eastern North America: Status and research needs. Results of a scientific workshop held May 5-8, 1992 at the Northeast Fisheries Science Center, Woods Hole, MA. NOAA, NMFS, NEFSC Ref. Doc. 92-06, Woods Hole, Massachusetts.

NMFS [National Marine Fisheries Service]. 1993. Proposed listing of Gulf of Maine population of harbor porpoises as threatened under the Endangered Species Act. Federal Register 58: 3108-3120, January 07, 1993.

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.

O'Boyle, R. N. and K. C. T. Zwanenburg (editors). Report of the Scotia-Fundy regional advisory process (RAP). Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2252.

Palka, D. 1994a. Correlations between sighting rates of harbor porpoises and environmental factors using sighting survey data collected in 1992 and 1993. Working paper No. 17 presented at the NMFS Harbor Porpoise Workshop - February 1994, NOAA, NMFS, NEFSC, Woods Hole, Massachusetts.

Palka, D. (editor). 1994b. Results of a Scientific workshop to evaluate the status of harbor porpoises (*Phocoena phocoena*) in the western North Atlantic. NOAA, NMFS, NEFSC [Northeast Fisheries Science Center] Ref. Doc. 94-09, Woods Hole, Massachusetts.

Palka, D. In press. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. Int. Whal. Commn. Special Issue 16.

Polacheck, T. 1989. Harbor porpoises and the gillnet fishery. Oceanus 32(1): 63-70.

Polacheck, T., F. W. Wenzel, and G. Early. In press. Rep. Int. Whal. Commn. Special Issue 16.

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.

Read, A. J. and A. A. Hohn. In press. Life in the fast lane: The life history of harbour porpoises from the Gulf of Maine. Mar. Mamm. Sci.

Smith, G. J. D., A. J. Read, and D. E. Gaskin. 1983. Incidental catch of harbor porpoises, *Phocoena phocoena* (L.), in herring weirs in Charlotte County, New Brunswick, Canada. Fish. Bull., U.S. 81(3): 660-2.

Smith, T., D. Palka, and K. Bisack. 1993. Biological Significance of by-catch of harbor porpoise in the Gulf of Maine demersal gillnet fishery. NOAA, NMFS, NEFSC [Northeast Fisheries Science Center] Ref. Doc. 93-23, Woods Hole, Massachusetts.

Walden, J. In review. Results of the Gulf of Maine gillnet survey 1989-92. NOAA, NMFS, NEFSC [Northeast Fisheries Science Center] Ref. Doc., Woods Hole, Massachusetts.

Woodley, T. H. and A. J. Read. 1991. Potential rates of increase of a harbor porpoise (*Phocoena phocoena*) population subjected to incidental mortality in commercial fisheries. Can. J. Fish. Aquat. 48:2429-35.

HARBOR SEAL (*Phoca vitulina*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harbor seal is found in the western North Atlantic, from the eastern Canadian Arctic and Greenland south to southern New England and New York, and occasionally to the Carolinas (Boulva and McLaren 1979; Katona et al. 1993). Although the stock structure of the western North Atlantic population is unknown, it is thought that harbor seals found along the eastern U.S. and Canadian coasts represent one population (P. M. Payne, personal communication, 1989).

Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona et al. 1993), and occur seasonally along the southern New England and New York coasts from September through late May (Schneider and Payne 1983). Scattered sightings and strandings have been recorded as far south as Georgia (NMFS unpublished data). A general southward movement from the Bay of Fundy to southern New England waters occurs in autumn and early winter (Rosenfeld et al. 1988; Whitman and Payne 1990). A northward movement from southern New England to Maine and eastern Canada occurs prior to the pupping season, which takes place from mid-May through June along the Maine Coast (Wilson 1978; Whitman and Payne 1990). No pupping areas have been identified in southern New England (Payne and Schneider 1984). The overall geographic range throughout coastal New England has not changed significantly during the last century (Payne and Selzer 1989).

The majority of animals moving into southern New England waters are juveniles. Whitman and Payne (1990) suggest that the age-related dispersal may reflect the higher energy requirements of younger animals.

POPULATION SIZE

Since passage of the MMPA in 1972, the number of seals along the New England coast has increased nearly five-fold. Summer aerial survey haul-out counts along the Maine Coast totaled 28,810 animals (Kenney and Gilbert 1994). This number is considered to be a minimum abundance estimate because it is uncorrected for animals in the water or outside the survey area. Increased abundance of seals in the northeast region has also been documented during aerial and boat surveys of overwintering haul-out sites in southern New England and eastern Long Island (Payne and Selzer 1989; V. Rough, personal communication). Canadian scientists counted 3,600 harbor seals during an August 1992 aerial survey in the Bay of Fundy (Stobo and Fowler 1994), but noted that the survey was not designed to obtain a population estimate.

Minimum Population Estimate

A minimum population estimate is 28,810 seals, based on uncorrected total counts along the Maine coast in 1993.

Current Population Trend

Based on 1981, 1982, 1986, and 1993 surveys conducted along the Maine coast, Kenney and Gilbert (1994) estimated a 8.7% annual rate of increase in Maine coastal waters. Possible factors contributing to this increase include MMPA protection and increased prey. There are no indications that population growth has slowed or that it is at or near its potential maximum level. The rapid increase observed during the past two decades may reflect past reduction of the population by historical bounty hunting, possibly to a very low level.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.12 for purposes of this assessment (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 1.0 because the stock size is known to be increasing. PBR for this stock is 1,729 harbor seals.

ANNUAL HUMAN-CAUSED MORTALITY

Harbor seals, were bounty hunted in New England waters until the late 1960's. This hunt may have caused the demise of this stock in U.S. waters (Katona et al. 1993).

Researchers and fishery observers have documented incidental mortality in several fisheries, particularly within the Gulf of Maine (see below). An unknown level of mortality also occurs in the mariculture industry (i.e., salmon farming), and by deliberate shooting (NMFS unpublished data).

An unknown number of harbor seals have been taken in Newfoundland and Labrador, Gulf of St. Lawrence and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy herring weirs (Read 1994). Furthermore, some of these mortalities (e.g., seals trapped in herring weirs) are the result of direct shooting. The Canadian government has recently implemented a pilot program that permits mariculture operators to use acoustic deterrents or shoot problem seals. The success of this program will be evaluated in April 1995 (J. Conway, Can. Dept. Fish. & Oceans, personal communication).

Average annual estimated fishery-related mortality and serious injury to this stock in the U.S. Exclusive Economic Zone (EEZ) during 1990-1993, based on observed fishery interactions, was 476 harbor seals (CV = 0.46). 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 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.

Fisheries Information

Incidental takes of harbor seals have been recorded in groundfish gillnet, herring purse seine, halibut tub trawl, and lobster fisheries (Gilbert and Wynne, 1985 and 1987). A study conducted by the University of Maine reported a combined average of 22 seals entangled annually by 17 groundfish gillnetters off the coast of Maine (Gilbert and Wynne 1987). All seals were young of the year and were caught from late June through August, and in early October. Interviews with a limited number of mackerel gillnetters indicated only one harbor seal entanglement and a negligible loss of fish to seals. Net damage and fish robbing were not reported to be a major economic concern to gillnetters interviewed (Gilbert and Wynne 1987).

Herring purse seiners have reported accidentally entrapping seals off the mid-coast of Maine, but indicated that the seals were rarely drowned before the seine was emptied (Gilbert and Wynne 1985). Capture of seals by halibut tub trawls are rare. One vessel captain indicted that he took one or two seals a year. These seals were all hooked through the skin and released alive, indicating they were snagged as they followed baited hooks. Infrequent reports suggest seals may rob bait off longlines, although this loss is considered negligible (Gilbert and Wynne 1985).

Incidental takes in lobster traps in inshore waters off Maine are reportedly rare. Captures of approximately two seal pups per port per year were recorded by mid-coastal lobstermen off Maine (Gilbert and Wynne 1985). Seals have been reported to rob bait from inshore lobster traps, especially in the spring, when fresh bait is used. These incidents may involve only a few individual animals. Lobstermen claim that seals consume shedding lobsters.

The Atlantic Canadian and Greenland salmon gillnet fishery is seasonal, with the peak from June to September, depending on location. In southern and eastern Newfoundland, and Labrador during 1989, 2,196 nets 91 m long were used. There is no effort data available for the Greenland fishery. However, the fishery was terminated in 1993 under an agreement between Canada and North Atlantic Salmon Fund (Read 1994).

The Canadian Atlantic groundfish gillnet fishery is important and widespread. Many fisherman hold groundfish gillnet licenses but the number of active fishermen is unknown. In 1989, approximately 6,800 licenses were issued to fishermen along the southern coasts of Labrador, and northeast and southern coast of Newfoundland. In the Gulf of St. Lawrence, there were about 3,900 licenses issued in 1989, while in the Bay of Fundy and southwestern Nova Scotia 659 licenses were issued.

There were 3,121 cod traps operating in Newfoundland and Labrador during 1979, and about 7,500 in 1980 (Read 1994). This fishery was closed at the end of 1993 due to collapse of Canadian groundfish resources.

Herring weirs are also distributed throughout the Bay of Fundy; it has been reported that 180 weirs were operating in the Bay of Fundy in 1990 (Read 1994).

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook 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 provides observer coverage of vessels fishing south of Cape Hatteras.

There are approximately 349 vessels (full and part time) in the New England multispecies sink gillnet fishery (Walden, in review). Observer coverage in terms of trips has been 1%, 6%, 7. 5%, and 5% for 1990 to 1993, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. There were 71 harbor seal mortalities, excluding three animals taken in the 1994 pinger experiment (NMFS unpublished data), observed in the New England multispecies sink gillnet fishery between 1990 and 1993. The estimated annual mortalities (CV in parentheses) in this fishery were 602 in 1990 (0.68), 231 in 1991 (0.22), 373 in 1992 (0.23), and 698 in 1993 (0.19). Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1990-1993 was 476 harbor seals (CV = 0.46). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack, in review). The by-catch occurred in Massachusetts Bay, south of Cape Ann and west of Stellwagen Bank during January-March. By-catch locations became more dispersed during April-June from Casco Bay to Cape Ann, along the 30 fathom contour out to Jeffreys Ledge, with one take location near Cultivator Shoal and one off southern New England near Block Island. Incidental takes occurred from Frenchman's Bay to Massachusetts Bay during July-September. In inshore waters, the takes were aggregated while offshore takes were more dispersed. Incidental takes were confined from Cape Elizabeth out to Jeffreys Ledge and south to Nantucket Sound during October-December.

Other Mortality

Small numbers of harbor seals regularly strand during the winter period in southern New England and mid-Atlantic regions (NMFS unpublished data). Sources of mortality include human interactions (boat strikes and fishing gear), storms, abandonment by the mother, and disease (Katona et al. 1993; NMFS unpublished data). In 1980, more than 350 seals were found dead in the Cape Cod area from an influenza outbreak (Geraci et al. 1981).

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

STATUS OF STOCK

The status of harbor seals, relative to OSP, in the U.S. EEZ is unknown, but the population is increasing. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada seals are protected from harassment and unauthorized killing under current Marine Mammal Regulations. Kenney and Gilbert (1994) estimated a 8.7% annual rate of increase of this stock in Maine coastal waters based on 1981, 1982, 1986, and 1993 surveys conducted along the Maine coast. The population is increasing despite the known fishery-related mortality. This is not a strategic stock because fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

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.

Boulva, J. and I. A. McLaren. 1979. Biology of the harbor seal, *Phoca vitulina*, in eastern Canada. Bull. Fish. Res. Bd. Can. 200:1-24.

Bravington, M. V. and K. D. Bisack. In review. Estimates of harbor porpoise by-catch in the Gulf of Maine sink gillnet fishery, 1990-93. Submitted to Fish. Bull.

Geraci, R., D. J. St. Aubin and I. K. Barker. 1981. Mass mortality of harbor seals: pneumonia associated with influenza A virus. Science 215: 1129-1131.

Gilbert, J. R. and K. M. Wynne. 1985. Harbor seal populations and fisheries interactions with marine mammals in New England, 1984. Interim Rep., NOAA NA-84-EAC-00070, NMFS, NEFSC., Woods Hole, MA, 15 pp.

Gilbert, J. R. and K. M. Wynne. 1987. Marine mammal interactions with New England gillnet fisheries. Final Report Contract No. NA-84-EAC-00070, NOAA, NMFS, NEFSC, Woods Hole, MA, 12 pp.

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, DC, 316 pp.

Kenney, M. K. and J. R. Gilbert. 1994. Increase in harbor and gray seal populations in Maine. Dept. of Commerce, NOAA-NMFS Contract Rep. 50-EANF-2-00064, 19 pp.

Payne, P. M. and L. A. Selzer. 1989. The distribution, abundance and selected prey of the harbor seal, *Phoca vitulina concolor*, in southern New England. Mar. Mamm. Sci. 5(2): 173-192.

Payne. P. M. and D. C. Schneider. 1984. Yearly changes in abundance of harbor seals, *Phoca vitulina*, at a winter haul-out site in Massachusetts. Fish. Bull., U.S. 82: 440-442.

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.

Rosenfeld, M., M. George, and J. M. Terhune. 1988. Evidence of autumnal harbour seal, *Phoca vitulina*, movement from Canada to the United States. Can. Field-Nat. 102(3): 527-529.

Schneider, D. C. and P. M. Payne. 1983. Factors affecting haul-out of harbor seals at a site in southeastern Massachusetts. J. Mamm. 64(3): 518-520.

Stobo, W.T. and G.M. Fowler. 1994. Aerial surveys of seals in the Bay of Fundy and off southwest Nova Scotia. Can. Tech. Rep. Fish. Aquat. Sci. 1943:57pp.

Walden, J. In review. Results of the Gulf of Maine gillnet survey 1989-92. NOAA, NMFS, NEFSC [Northeast Fisheries Science Center] Ref. Doc., Woods Hole, Massachusetts.

Whitman, A. A. and P. M. Payne. 1990. Age of harbour seals, *Phoca vitulina concolor*, wintering in southern New England. Can. Field-Nat. 104(4): 579-582.

Wilson, S. C. 1978. Social organization and behavior of harbor seals, *Phoca concolor*, in Maine. Final Report to Marine Mammal Commission, Contract MM6ACO13, GPO-PB-280-188.

GRAY SEAL (*Halichoerus grypus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

There is one gray seal stock in the western North Atlantic; it ranges from New England to Labrador and is centered in the Gulf of St. Lawrence (Katona et al. 1993; Davies 1957). This stock is separated by both geography and differences in the breeding season from the eastern Atlantic stock (Bonner 1981). The western Atlantic stock is distributed and breeds principally in eastern Canadian waters; however, small numbers of animals and pupping have been observed on several isolated islands along the Maine coast and in Nantucket-Vineyard Sound, Massachusetts (Katona et al. 1993; Rough 1995; J. R. Gilbert, personal communication).

POPULATION SIZE

A winter breeding colony on Muskeget Island, west of Nantucket Island, may provide some measure of gray seal population trends and expansion in distribution. Sightings in New England increased during the 1980s as the gray seal population and range expanded in eastern Canada. Five pups were born at Muskeget in 1988. The number of pups increased to 12 in 1992, 30 in 1993, and 59 in 1994. Maximum counts obtained during the spring molt did not exceed 13 in any year during the 1970s, but rose to 61 in 1984, 192 in 1988, 503 in 1992, and 1,549 in 1993. Aerial surveys in April and May of 1994 recorded a peak count of 2,035 gray seals for Muskeget Island (Nantucket) and Monomoy (Cape Cod) combined (Rough 1995).

Estimates of the total western Atlantic gray seal population are not available. Pup production on Sable Island, Nova Scotia, has been about 13 percent per year since 1962 (Mohn and Bowen 1994). The 1986 population estimate for individuals that are one year old and older was between 100,000 and 130,000 animals (Stobo and Zwanenburg 1990). The 1993 estimate (Sable Island and Gulf of St. Lawrence stocks) is 143,000 animals (Mohn and Bowen 1994). The population in waters off Maine has increased from about 30 in the early 1980's to between 500-1,000 animals in 1993 (J. R. Gilbert, personal communication, 1994).

Minimum Population Estimate

The minimum population estimate, based on uncorrected total counts (see above), is 2,035 gray seals.

Current Population Trend

Gray seal abundance is likely increasing in the U.S. Atlantic Exclusive Economic Zone (EEZ), but the actual trend is unknown. The population has been increasing for several decades in Canadian waters. Approximately 57% of the western North Atlantic population is from the Sable Island stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. Pup production on Sable Island is about 13% annually (Mohn and Bowen 1994), slightly above the theoretical "default" maximum net productivity rate for pinnipeds (0.12) used in this assessment.

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 1.0 for pinniped stocks that are increasing at about 90% of maximum potential rate. PBR for this stock is 122 gray seals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Gray seals, like harbor seals, were hunted for bounty in New England waters until the late 1960's. This hunt may have severely depleted this stock in U.S. waters (Rough 1995).

Researchers and fishery observers have documented incidental mortality in several fisheries in recent years, particularly within the Gulf of Maine. There were three records of incidental catch of gray seals in the 1989-1993

Northeast Fisheries Science Center (NEFSC) Sea Sampling database. All occurred in 1993 (February, March, and May) in the sink gillnet fishery. Two records were from the Gulf of Maine, and the third, in May, was from SE of Block Island. In addition, V. Rough (personal communication) has documented several animals with netting around their necks in the Cape Cod/Nantucket area. An unknown level of mortality also occurs in the mariculture industry (i.e., salmon farming) and by deliberate shooting (NMFS unpublished data). There are 79 records of stranded gray seals in the Northeast Marine Mammal Stranding Network database for 1989-1993.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

An unknown number of gray seals have been taken in Newfoundland and Labrador, Gulf of St. Lawrence, and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy herring weirs (Read 1994). In addition to incidental catches, some mortalities (e.g., seals trapped in herring weirs) were the result of direct shooting, and there were culls of about 1,700 animals annually during the 1970's and early 1980's on Sable Island (Anon. 1986).

Because of fishermen's concerns regarding gray seal predation on economically important fish stocks and transmission of the cod worm, Canada now has an open season (March-December) on gray seals (J. Conway, personal communication). The number of gray seals shot each year is unknown.

Estimated average annual fishery-related mortality and serious injury to this stock in the U.S. Atlantic EEZ during 1990-1993 was 4.5 gray seals (CV = 2.00). The total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be 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 Atlantic Canadian and Greenland salmon gillnet fishery is seasonal, with the peak from June to September, depending on location. In southern and eastern Newfoundland, and Labrador during 1989, 2,196 nets 91 m long were used. There is no effort data available for the Greenland fishery. However, the fishery was terminated in 1993 under an agreement between Canada and North Atlantic Salmon Fund (Read 1994).

The Canadian Atlantic groundfish gillnet fishery is important and widespread. Many fisherman hold groundfish gillnet licenses but the number of active fishermen is unknown. In 1989, approximately 6,800 licenses were issued to fishermen along the southern coast of Labrador, and northeast and southern coasts of Newfoundland. There were about 3,900 licenses issued in the Gulf of St. Lawrence in 1989, while 659 licenses were issued in the Bay of Fundy and southwestern Nova Scotia.

There were 3,121 cod traps operating in Newfoundland and Labrador during 1979, and about 7,500 in 1980 (Read 1994). This fishery was closed at the end of 1993 due to collapse of Canadian groundfish resources.

Herring weirs are also distributed throughout the Bay of Fundy; it has been reported that 180 weirs were operating in the Bay of Fundy in 1990 (Read 1994).

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The 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 provides observer coverage of vessels fishing south of Cape Hatteras.

There are approximately 349 vessels (full and part time) in the New England multispecies sink gillnet fishery (Walden, in review). Observer coverage in trips has been 1%, 6%, 7. 5%, and 5% for years 1990 to 1993. The fishery has been observed in the Gulf of Maine and in Southern New England. Three mortalities were observed in this fishery in 1993, in winter off the Massachusetts coast. The estimated mortality in 1993 was 18 gray seals (CV = 1.00). Estimated average annual fishery-related mortality and serious injury to this stock during 1990-1993 attributable to this fishery was 4.5 gray seals (CV = 2.00).

STATUS OF STOCK

The status of the gray seal population, relative to OSP, in U.S. and Canadian Atlantic coast waters is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. Recent data indicate that this population is increasing. In New England waters, both the number of pupping sites and pup production is increasing. In Canada they are protected from harassment and intentional killing under the Marine Mammal Regulations, although some aquaculture operators have been authorized to shoot nuisance animals. The estimated annual level of human-caused mortality and serious injury in the U.S. Atlantic EEZ does not exceed PBR and this is not a strategic stock.

REFERENCES

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.

Anon. 1986. Seals and sealing in Canada. Rep. of the Royal Commission on Seals and Sealing, Vol. 1, 65 pp. Available from Canadian Government Publishing Centre, Ottawa, Canada.

Bonner, W. N. 1981. Grey seal *Halichoerus grypus Fabricus*, 1791. Pages 111-144 *in* S. H. Ridgeway and R. J. Harrison (editors), Handbook of Marine Mammals, Vol. 2: Seals. Academic Press, London, 359 pp.

Davies, J. L. 1957. The geography of the gray seal. J. Mamm. 38: 297-310.

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, DC. 316 pp.

Mohn, R. and W. D. Bowen. 1994. A model of grey seal predation on 4VsW cod and its effects on the dynamics and potential yield of cod. DFO Atlantic Fisheries Res. Doc. 94/64.

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.

Rough, V. 1995. Gray seals in Nantucket Sound, Massachusetts, winter and spring, 1994. Final report to Marine Mammal Commission, Contract T10155615, 28 pp. NTIS Pub. PB95-191391.

Stobo, W. T. and K. C. T. Zwanenburg. 1990. Grey seal (*Halichoerus grypus*) pup production on Sable Island and estimates of recent production in the northwest Atlantic. Pages 171-184 *in* W. D. Bowen (editor), Population biology of sealworm (*Pseudoterranova decipiens*) in relation to its intermediate and seal hosts. Can. Bull. Fish. and Aq. Sci. 222.

Walden, J. (In review). Results of the Gulf of Maine gillnet survey 1989-92. NOAA, NMFS, NEFSC, Woods Hole, Massachusetts. NEFSC [Northeast Fisheries Science Center] Ref. Doc. 95.

HARP SEAL (*Phoca groenlandica*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harp seal occurs throughout much of the North Atlantic and Arctic Oceans (Ronald and Healey 1981; Lavigne and Kovacs 1988); however, in recent years numbers of sightings and strandings have been increasing off the east coast of the United States from Maine to New Jersey (Katona et al. 1993). These appearances usually occur in January-May, when the western North Atlantic stock of harp seals is at its most southern point of migration. The worlds' harp seal population is divided into three separate stocks, each identified with a specific breeding site (Bonner 1990; Lavigne and Kovacs 1988). The largest stock is located in the western North Atlantic off eastern Canada and is divided into two breeding herds which breed on the pack ice. The Front herd breeds off the coast of Newfoundland and Labrador and the Gulf herd breeds near the Magdalen Islands in the middle of the Gulf of St. Lawrence (Lavigne and Kovacs 1988). The second stock breeds in the White Sea off the coast of the Soviet Union and the third stock breeds on the West Ice off of eastern Greenland (Lavigne and Kovacs 1988).

Harp seals are highly migratory. Breeding occurs at different times between mid-February and April for each stock. Adults then assemble north of their whelping patches to undergo the annual moult. The migration then continues north to summer feeding grounds. In late September, after a summer of feeding, nearly all adults and some of the immature animals swim southward ahead of the advancing ice enroute to winter breeding and pupping grounds.

The extreme southern limit of the harp seal's habitat extends into the U.S. Atlantic Exclusive Economic Zone (EEZ) during winter and spring. The Northeast Marine Mammal Stranding Network reported an annual average of eight harp seals stranded during 1989-92. Strandings increased to between 45-50 per year in 1993-94 and, in addition to Massachusetts, carcasses were recovered in Connecticut, New York, and New Jersey (Rubinstein 1994). The increased number of strandings may indicate a possible shift in distribution or expansion southward into U.S. waters; if so, fishery interactions may increase.

POPULATION SIZE

The total population size of harp seals is unknown; however, seasonal abundance estimates are available which used a variety of methods including aerial surveys, and mark-recapture. Generally, these methods include surveying the whelping concentrations and mathematically modeling pup production. Harp seal pup production in the 1950s was estimated at 645,000 (Sergeant 1975), decreasing to 225,000 by 1970 (Sergeant 1975). Estimates began to increase at this time and have continued to rise, reaching 478,000 in 1979 (Bowen and Sergeant 1985) and 577,900 in 1990 (Stenson et al. 1993). Roff and Bowen (1983) developed an estimation model to provide a more precise estimate of total population. This technique incorporates recent pregnancy rates and estimates of age-specific hunting mortality (CAFSAC 1992). Total population can be determined by multiplying pup production by a factor between 5.35 and 5.38, giving a total of approximately three million harp seals in 1990. Shelton et al. (1992) applied a harp seal estimation model to the 1990 pup production and obtained an estimate of 3.1 million (range 2.7-3.5 million; Stenson 1993).

Minimum population estimate

Present data are insufficient to calculate this value for U.S. waters. It is estimated there are at least 2.7 million harp seals in Canada.

Current population trend

The population appears to be increasing in U.S. waters, judging from the increased number of stranded harp seals, but the magnitude of the suspected increase is unknown. In Canada, the average annual growth rate has been estimated to be about 7% (Stenson 1993).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The most appropriate data are based on Canadian studies. Recent studies indicate that pup production has increased but the rate of population increase cannot be quantified at this time (Stenson 1993).

POTENTIAL BIOLOGICAL REMOVAL

No PBR can be estimated for this species at this time, because the minimum population size in U.S. waters cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no records of harp seals in the NEFSC 1989-1993 Sea Sampling by-catch database; however, 40-50 seals which identified by observers as harbor seals in spring 1994 may have, in fact, been harp seals. Biological and photographic data from takes are under review.

An unknown number of harp seals have been taken in Newfoundland and Labrador groundfish gillnets (Read 1994). Harp seals are being taken in Canadian lumpfish and groundfish gillnets, and trawls, but estimates of total removals have not been calculated to date (Anon. 1994). Harp seals have been commercially hunted since the mid-1800's in the Canadian Atlantic (Stenson 1993). A total allowable catch (TAC) of 200,000 harp seals was set for the large vessel hunt in 1971. The TAC varied until 1982 when it was set at the current level of 186,000 seals (Stenson 1993). Catches ranged from 53,000 to 95,000 between 1988-1992 (Stenson 1993).

The total fishery-related mortality and serious injury for this stock is believed to be very low relative to the population size in Canadian waters and can 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 Atlantic Canadian and Greenland salmon gillnet fishery is seasonal, with the peak from June to September, depending on location. During 1989, 2,196 nets 91 m in length were used in southern and eastern Newfoundland, and Labrador. There are no effort data available for the Greenland fishery and the fishery was terminated in 1993 under an agreement between Canada and North Atlantic Salmon Fund (Read 1994).

The Canadian Atlantic groundfish gillnet fishery is important and widespread. Many fisherman hold groundfish gillnet licenses but the number of active fishermen is unknown. In 1989, approximately 6,800 licenses were issued to fishermen along the southern coast of Labrador and the northeast and southern coasts of Newfoundland. In the Gulf of St. Lawrence, there were about 3,900 licenses issued in 1989, while in the Bay of Fundy and southwestern Nova Scotia 659 licenses were issued.

There were 3,121 cod traps operating in Newfoundland and Labrador during 1979, and about 7,500 in 1980 (Read 1994). This fishery was closed at the end of 1993 due to collapse of Canadian groundfish resources.

STATUS OF STOCK

The status of the harp seal stock, relative to OSP, in the U.S. EEZ is unknown, but the population appears to be increasing in Canadian waters. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada they are protected from harassment and intentional killing is controlled under the Marine Mammal Regulations. The level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is unknown, but believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

REFERENCES

Anon. 1994. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals, Copenhagen, 15-21 September 1993. ICES C. M. 1994/Assess, 45 pp.

Bonner, W. N. 1990. The natural history of seals. Fact on File, New York, 196 pp.

Bowen, W. D. and D. E. Sergeant. 1985. A Mark-recapture estimate of 1983 Harp seal Pup Production in the Northwest Atlantic. NAFO SCR. Doc. 85/I/1.

CAFSAC. 1992. Update on population estimates of Harp seal in the Northwest Atlantic. Canadian Atlantic Fisheries Scientific Advisory Committee, CAFSAC Adv. Doc. 92/8

Lavigne, D. M. and K. M. Kovacs. 1988. Harps and Hoods Ice Breeding Seals of the Northwest Atlantic. University of Waterloo Press, Waterloo, Ontario, Canada, 174 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.

Roff, D. A. and W. D. Bowen. 1983. Population dynamics and management of the Northwest Atlantic harp seal. Can. J. Fish. Aquat. Sci. 40: 919-932.

Ronald, K. and P. J. Healey. 1981. Harp Seal. Pages 55-87 *in* S. H. Ridgway and R. J. Harrison (editors), Handbook of marine mammals, Vol. 2: Seals. Academic Press, New York, 359 pp.

Rubinstein, B. 1994. An apparent shift in distribution of ice seals, *Phoca groenlandica*, *Cystophora cristata*, and *Phoca hispida*, toward the east coast of the United States. M.A. Thesis, Boston University, Boston, MA, 45 pp.

Sergeant, D. E. 1975. Estimating numbers of Harp seals. Rapp. P. -v. Reun. Cons. Int. Explor. Mer. 169: 274-280.

Shelton, P. A., N. G. Caddigan and G. B. Stenson. 1992. Model estimates of harp seal population trajectories in the Northwest Atlantic. CAFSAC Res. Doc. 92/89, 23 pp.

Stenson, G. B. 1993. The status of pinnipeds in the Newfoundland region. NAFO SCR Doc. 93/34.

Stenson, G. B., R. A. Myers, M. O. Hammill, I-H Ni, W. G. Warren, and M. S. Kingsley. 1993. Pup Production of Harp Seals, *Phoca groenlandica*, in the Northwest Atlantic. Can. J. Fish. Aquat. Sci. 50: 2429-2439.

HOODED SEAL (*Cystophora cristata*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The hooded seal occurs throughout much of the North Atlantic and Arctic Oceans (King 1983) preferring deeper water and occurring farther offshore than harp seals (Lavigne and Kovacs 1988). Hooded seals tend to wander far out of their range and have been seen as far south as Puerto Rico, with increased occurrences from Maine to Florida. These appearances usually occur between January and May. Although it is not known which stock these seals come from, it is known that during this time frame, the Northwest Atlantic stock of hooded seals are at their most southern point of migration in the Gulf of St. Lawrence. The worlds' hooded seal population is divided into three separate stocks, each identified with a specific breeding site (Lavigne and Kovacs 1988). One stock, which whelps off the coast of eastern Canada, is divided into two breeding herds which breed on the pack ice. The Front herd breeds off the coast of Newfoundland and Labrador and the Gulf herd breeds in the Gulf of St. Lawrence. The second stock breeds on the White Ice off eastern Greenland and the third stock occurs in the Davis Strait.

Hooded seals are a highly migratory species. Breeding occurs at the same time for each stock in February. Adults from all stocks then assemble in the Denmark Strait to moult between June and August (King 1983), and following this, the seals disperse widely. Some move south and west around the southern tip of Greenland, and then north along the west coast of Greenland. Others move to the east and north between Greenland and Svalbard during late summer and early fall (Lavigne and Kovacs 1988). Little else is known about the activities of hooded seals during the rest of the year until they assemble again in February for breeding.

Hooded seals are rarely found in the U.S. Atlantic Exclusive Economic Zone. Small numbers of hooded seals at the extreme southern limit of their range occur in the winter and spring seasons. The Northeast Marine Mammal Stranding Network reports an average of seven hooded seals stranded annually from 1989-92. In 1993-94, strandings increased to between 19-24 a year and carcasses were recovered from Massachusetts, Connecticut, and New York (Rubinstein 1994). The increased number of strandings may indicate a possible shift in distribution or range expansion southward into U.S. waters; if so, fishery interactions may increase.

POPULATION SIZE

The number of hooded seals in the western North Atlantic is unknown. Seasonal abundance estimates are available based on a variety of methods including aerial surveys. These methods often include surveying the whelping concentrations and mathematically modeling the pup production. Hooded seal pup production between 1966 and 1971 was estimated between 27,000 and 41,000 annually (Benjaminsen and Oritsland 1975). Estimated pup production dropped to 26,000 hooded seal pups in 1978 (Winters 1978). Pup production estimates began to increase after 1978, reaching 62,000 by 1984 (Hay et al. 1985), and rose to 82,000 in 1990 (Hammill et al. 1992). No recent population estimate is available, but assuming a ratio of pups to total population of 1:5, pup production in the Gulf and Front herds would represent a total population of approximately 400,000-450,000 hooded seals (Stenson 1993). It appears that the number of hooded seals is increasing.

Minimum population estimate

Present data are insufficient to calculate this value for U.S. waters. It is estimated that there are approximately 400,000 hooded seals in Canadian waters.

Current population trend

The population appears to be increasing in U.S. Atlantic EEZ, judging from stranding records, although the actual magnitude of this increase is unknown. The Canadian population appears to be increasing but, because different methods have been used over time to estimate population size, the magnitude of this increase has not been quantified.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The most appropriate data are based on Canadian studies. Pup production in Canada may be increasing slowly (5% per annum), but due to the wide confidence intervals and lack of understanding regarding stock dynamics, it is possible that pup production is stable or declining (Stenson 1993).

POTENTIAL BIOLOGICAL REMOVAL

No PBR can be estimated for this species at this time, because the minimum population size in U.S. waters cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no records of fishery-related mortality to hooded seals in the NEFSC 1989-1993 Sea Sampling database.

An unknown number of hooded seals have been taken in Newfoundland and Labrador groundfish gillnets (Read 1994). The following summary on the hooded seal fishery is taken from (Stenson 1993). In Atlantic Canada, hooded seals have been commercially hunted at the Front since the late 1800's. In 1974 total allowable catch (TAC) was set at 15,000, and reduced to 12,000 in 1983 and to 2,340 in 1984. In 1991 the TAC was increased to 15,000. A TAC of 8,000 was set for 1992 and 1993. From 1974 through 1982, the average catch was 12,800 animals, mainly pups. Since 1983 catches ranged from 33 in 1986 to 6,321 in 1991, with a mean catch of 1,116 between 1983 and 1992.

Hunting in the Gulf of St. Lawrence has been prohibited since 1964. No commercial hunting of hooded seals is permitted in the Davis Strait.

The total fishery-related mortality and serious injury for this stock is very low relative to the population size, especially in Canadian waters. This mortality can 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

No hooded seals have been taken incidentally in U.S. waters.

The Canadian Atlantic groundfish gillnet fishery is important and widespread. Many fisherman hold groundfish gillnet licenses but the number of active fishermen is unknown. In 1989, approximately 6,800 licenses were issued to fishermen along the southern coast of Labrador and the northeast and southern coasts of Newfoundland. There were about 3,900 licenses issued in 1989 in the Gulf of St. Lawrence, while in the Bay of Fundy and southwestern Nova Scotia 659 licenses were issued.

There were 3,121 cod traps operating in Newfoundland and Labrador during 1979, and about 7,500 in 1980 (Read 1994). This fishery was closed at the end of 1993 due to collapse of Canadian groundfish resources.

Hooded seals are being taken in Canadian lumpfish and groundfish gillnets and trawls; however, estimates of total removals have not been calculated to date (Anon. 1994).

STATUS OF STOCK

The status of hooded seals relative to OSP is unknown. They are not listed as threatened or endangered under the Endangered Species Act. In Canada they are protected from harassment and intentional killing is controlled under the Marine Mammal Regulations. This is not a strategic stock because the level of human-caused mortality and serious injury is believed to be very low relative to overall stock size.

REFERENCES

Anon. 1994. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals, Copenhagen, 15-21 September 1993. ICES C. M. 1994/Assess, 45 pp.

Benjaminsen, T., and T. Oritsland. 1975. The survival of year-classes and estimates of production and sustainable yield of northwest Atlantic harp seals. Int. Comm. Northwest Atl. Fish. Res. Doc. 75/121.

Hammill, M. O., G. B. Stenson, and R. A. Myers. 1992. Hooded seal (*Cystophora cristata*) pup production in the Gulf of St. Lawrence. Can. J. Fish. Aquat. Sci. 49: 2546-2550.

Hay, K., G. B. Stenson, D. Wakeham, and R. A. Myers. 1985. Estimation of pup production of hooded seals (*Cystophora cristata*) at Newfoundland during March 1985. Con. Atl. Fish. Sci. Adv. Comm. 85/96.

King, J. E. 1983. Seals of the World. Cornell University Press, Ithaca, NY, 240 pp.

Lavigne, D. M. and K. M. Kovacs. 1988. Harps and Hoods Ice Breeding Seals of the Northwest Atlantic. University of Waterloo Press, Waterloo, Ontario, Canada, 174 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.

Rubinstein, B. 1994. An apparent shift in distribution of ice seals, *Phoca groenlandica*, *Cystophora cristata*, and *Phoca hispida*, toward the east coast of the United States. M.A. Thesis, Boston University, Boston, MA, 45 pp.

Stenson, G. B. 1993. The status of pinnipeds in the Newfoundland region. NAFO SCR Doc. 93/34.

Winters, G. H. 1978. Production, mortality, and sustainable yield of northwest Atlantic harp seals (*Pagophilus groenlandicus*). J. Fish. Res. Bd. Can. 35: 1249-1261.

SPERM WHALE (*Physeter macrocephalus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sperm whales are found throughout the world's oceans in deep waters from between about 60° N and 60° S latitudes (Leatherwood and Reeves 1983; Rice 1989). There has been speculation, based on year round occurrence of strandings, opportunistic sightings, and whaling catches, that sperm whales in the Gulf of Mexico may constitute a distinct stock (Schmidly 1981), but there is no information on stock differentiation. Seasonal aerial surveys confirm that sperm whales are present in the northern Gulf of Mexico in all seasons, but sightings are more common during the summer months (Mullin et al. 1991; Davis et al., in preparation).

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of sperm whales by survey year [coefficient of variation (CV) in parentheses] was 143 in 1991 (0.58), 931 in 1992 (0.48), 229 in 1993 (0.52), and 771 in 1994 (0.42) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of sperm whales for all surveys combined was 530 (CV = 0.31) (Hansen et al. 1995).

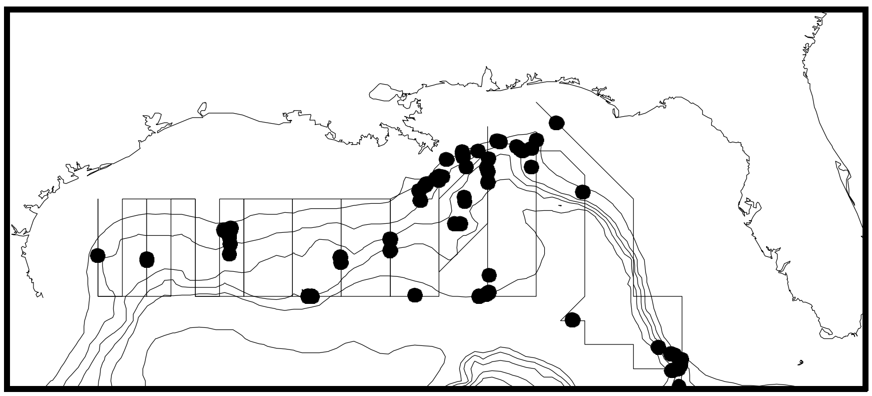


Figure 1. *Distribution of sperm whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two ship surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

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, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate was calculated from the 1991-1994 average abundance estimate of 530 sperm whales (CV = 0.31) (Hansen et al. 1995) and is 411 sperm whales.

Current Population Trend

No trend was discernable in the average annual abundance estimates. All of the log-normal 95% confidence intervals of the annual estimates overlap, indicating that the estimates were not significantly different at that level. The variation in abundance estimates may represent inter-annual variation in distribution, rather than a change in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was 0.10 because sperm whales are an endangered species. The resulting PBR for this stock is 0.8 sperm whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

A commercial fishery for sperm whales operated in the Gulf of Mexico during the late 1700's to the early 1900's, but the exact number of whales taken is not known (Townsend 1935).

The level of current, direct, human-caused mortality and serious injury of sperm whales in the northern Gulf of Mexico is unknown, but available information indicates there likely is little, if any, fisheries interaction with sperm whales in the northern Gulf of Mexico.

There were no documented strandings of sperm whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to sperm whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

Other Mortality

A total of nine sperm whale strandings were documented in the northern Gulf of Mexico during 1987-1994. One of the whales had deep, parallel cuts posterior to the dorsal ridge that were believed to be caused by the propeller of a large vessel. This trauma was assumed to be the proximate cause of this stranding.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

STATUS OF STOCK

Stock size is considered to be low relative to OSP and the species is therefore listed as endangered under the Endangered Species Act (ESA). There are insufficient data to determine population trends. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant; however, because this species is listed as endangered and there is presently no recovery plan in place, any fishery-related mortality would be unlawful. This is a strategic stock because the sperm whale is listed as an endangered species under the ESA.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris, and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana, 108 pp.

Rice, D. W. 1989. Sperm whale, *Physeter macrocephalus* Linnaeus, 1758. Pages 177-233 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 4: river dolphins and the larger toothed whales. Academic Press, London, 442 pp.

Schmidly, D. J. 1981. Marine mammals of the southeastern United States and the Gulf of Mexico. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC, FWS/OBS-80/41, 165 pp.

Townsend, C. H. 1935. The distribution of certain whales as shown by logbook records of American whale ships. Zoologica 19: 1-50.

BRYDE'S WHALE (*Balaenoptera edeni*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bryde's whales are considered the tropical and sub-tropical baleen whale of the world's oceans. In the western Atlantic, Bryde's whales are reported from off the southeastern United States and the southern West Indies to Cabo Frio, Brazil (Leatherwood and Reeves 1983). It is postulated that the Bryde's whales found in the Gulf of Mexico may represent a resident stock (Schmidly 1981; Leatherwood and Reeves 1983), but there is no information on stock differentiation. Most sightings of Bryde's whales have occurred during the spring-summer months (Hansen et al. 1995; Davis et al., in preparation), but strandings have occurred throughout the year (Jefferson et al. 1992).

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. The estimated abundance of Bryde's whales by survey year was 218 in 1991 (coefficient of variation, CV = 1.01) and zero in 1992, 1993, and 1994 (Hansen et al. 1995). Survey effort-weighted estimated average abundance of Bryde's whales for all surveys combined was 35 (CV = 1.10) (Hansen et al. 1995) and was based on only three sightings, all of which occurred in 1991.

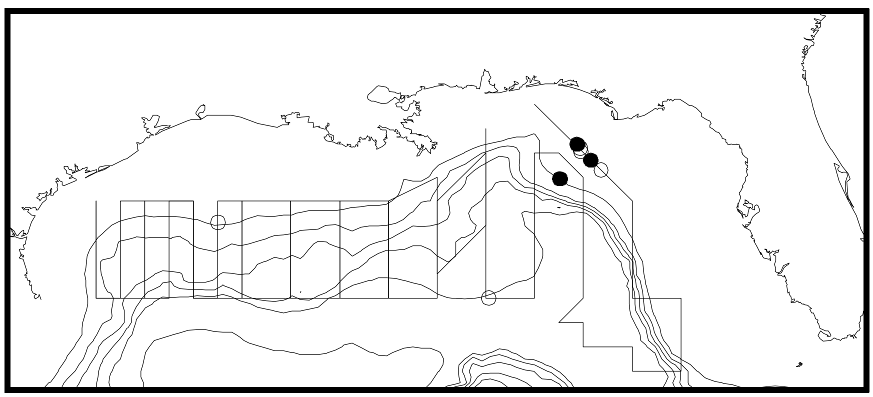


Figure 1. *Distribution of Bryde's whale sightings (filled circles) and unidentified balaenopterid whales (unfilled circles) during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two ship surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

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, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate was based on the 1991-1994 average estimated abundance of Bryde's whales which was 35 (CV = 1.10) (Hansen et al. 1995) and is 17 Bryde's whales.

Current Population Trend

The abundance estimates decreased to zero for survey years 1992-1994 because Bryde's whales were not sighted during vessel surveys those years. This could be due to chance rather than to a decrease in population size and the result of a relatively small population size and low sampling intensity or it could be due to inter-annual variation in distribution.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. The resulting PBR for this stock is 0.2 Bryde’s whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of Bryde's whales in the northern Gulf of Mexico is unknown, but available information indicates there is little fisheries interaction with Bryde's whales in the northern Gulf of Mexico. There was one report of a Bryde’s whale entangled in line, but the line was removed and the animal released alive.

There were no documented strandings of Bryde’s whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to Bryde’s whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

Other Mortality

No human-caused mortality has been reported for this stock.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant; therefore, this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Jefferson, T. A., S. Leatherwood, L. K. M. Shoda and R. L. Pitman. 1992. Marine mammals of the Gulf of Mexico: a field guide for aerial and shipboard observers. Texas A&M University Printing Center, College Station, Texas, 92 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Schmidly, D. J. 1981. Marine mammals of the southeastern United States and the Gulf of Mexico. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC, FWS/OBS-80/41, 165 pp.

CUVIER'S BEAKED WHALE (*Ziphius cavirostris*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Cuvier's beaked whales are distributed throughout the world's oceans except for the polar regions (Leatherwood and Reeves 1983; Heyning 1989). Strandings have occurred in all months along the United States east coast (Schmidly 1981) and have been documented throughout the year in the Gulf of Mexico. Strandings of Cuvier's beaked whales along the west coast of North America, based on skull characteristics, are thought to represent members of a panmictic population (Mitchell 1968), but there is no information on stock differentiation in the Gulf of Mexico and nearby waters.

Beaked whales were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico (Davis et al., in preparation). Some of the aerial survey sightings may have included Curvier's beaked whale, but identification of beaked whale species from aerial surveys is problematic.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. The estimated abundance [coefficient of variation (CV) in parentheses] by survey year was zero in 1991and 1992, 70 in 1993 (0.63), and 38 in 1994 (0.80) (Hansen et al. 1995). Survey effort-weighted estimated average abundance average abundance of Cuvier's beaked whales was 30 (CV = 0.50) (Hansen et al. 1995). The estimated abundance of Curvier's beaked whales is probably low because only sightings of beaked whales which could be positively identified to species were used.

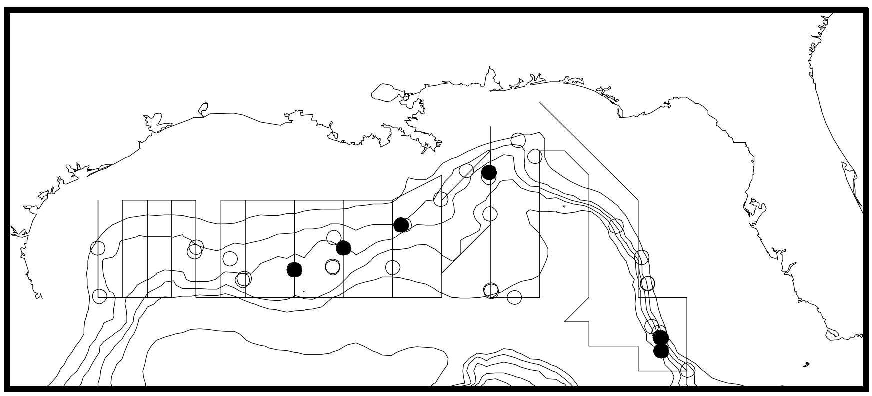


Figure 1. *Distribution of Curvier's beaked whale sightings (filled circles) and unidentified beaked whale sightings (unfilled circles) during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population estimate was based on average estimated abundance of Cuvier's beaked whales for all surveys combined which was 30 whales (CV = 0.50) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 20 Cuvier's beaked whales.

Current Population Trend

The abundance estimates were zero in 1991 and 1992, and then increased for 1993 and 1994. Cuvier's beaked whales were not sighted during the 1991 and 1992 vessel surveys. This could be due to chance given the small estimated population size and sampling intensity or inter-annual variation in distribution, rather than a change in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. PBR for this stock is 0.2 Cuvier's beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Cuvier's beaked whales were taken occasionally in a small, directed fishery for cetaceans that operated out of the Lesser Antilles (Caldwell and Caldwell 1971).

The actual level of past or current, direct, human-caused mortality of Cuvier's beaked whales in the northern Gulf of Mexico is unknown, but there have been no reports of fishery-related mortality or serious injury to beaked whales by U.S. fisheries in the Gulf of Mexico. Available information indicates there likely is little, if any, fisheries interaction with Cuvier's beaked whales in the northern Gulf of Mexico.

There were no documented strandings of Cuvier's beaked whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to Cuvier's or any beaked whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant; therefore, this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Caldwell, D. K. and M. C. Caldwell. 1971. Beaked whales, Ziphius cavirostris, in the Bahamas. Florida Academy of Science Quarterly Journal. 34: 157-160.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Heyning, J. E. 1989. Cuvier's beaked whale *Ziphius cavirostris* G. Cuvier, 1923. Pages 289-308 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales, Academic Press, London, 442 pp.

Jefferson, T. A., S. Leatherwood, L. K. M. Shoda and R. L. Pitman. 1992. Marine mammals of the Gulf of Mexico: a field guide for aerial and shipboard observers. Texas A&M University Printing Center, College Station, 92 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Schmidly, D. J. 1981. Marine mammals of the southeastern United States and the Gulf of Mexico. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC, FWS/OBS-80/41, 165 pp.

BLAINVILLE'S BEAKED WHALE (*Mesoplodon densirostris*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Only three species of *Mesoplodon* are known, from strandings and/or sightings, to occur in the Gulf of Mexico (Jefferson et al. 1992; Hansen et al. 1995). These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*), and Sowerby's beaked whale (*M. bidens*). The occurrence of Sowerby's beaked whale in the Gulf of Mexico is considered extralimital because there is only one known stranding of this species in the Gulf of Mexico (Bonde and O'Shea 1989) and because it normally occurs in northern temperate waters of the North Atlantic (Mead 1989).

Identification of *Mesoplodon* species at sea is problematic; therefore, nearly all sightings of these species are identified as beaked whales and may include sightings of *Ziphius cavirostris* that were not identified as such. Beaked whales were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico (Davis et al., in preparation).

Blainville's beaked whales appear to be widely but sparsely distributed in warm temperate and tropical waters of the world's oceans (Leatherwood et al. 1976; Leatherwood and Reeves 1983). Strandings have occurred along the northwestern Atlantic coast from Florida to Nova Scotia (Schmidly 1981), and there have been two documented strandings of this species in the northern Gulf of Mexico and one sighting (Jefferson et al. 1992; Hansen et al. 1995). There is no information on stock differentiation.

POPULATION SIZE

Estimates of abundance of beaked whales were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Survey effort-weighted estimated average abundance of beaked whales not identified to species for all surveys combined was 117 (coefficient of variation, CV = 0.38) (Hansen et al. 1995). Estimated beaked whale abundance (CV in parentheses) by survey year was 129 in 1991 (0.78),18 in 1992 (1.27), 53 in 1993 (0.78), and 287 in 1994 (0.48) (Hansen et al. 1995). These estimates may also include an unknown number of Cuvier's beaked whales (*Ziphius cavirostris*) and abundance of Blainville's beaked whale cannot be estimated due to uncertainty of species identification at sea.

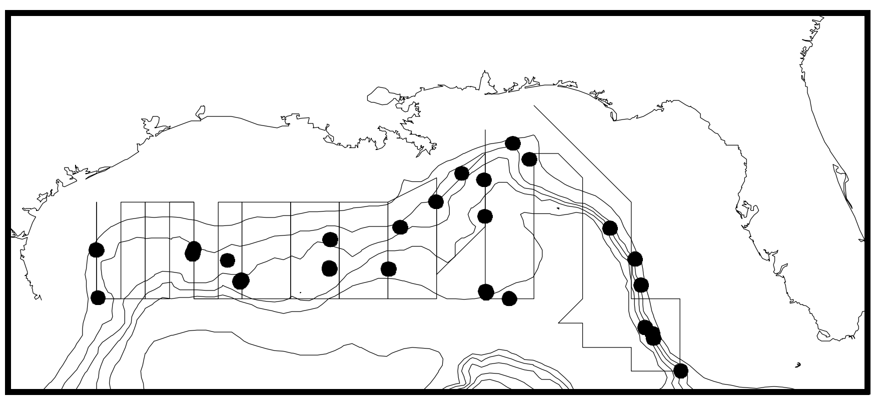


Figure 1. *Distribution of beaked whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

A minimum population estimate was not calculated because of uncertainty of species identification of sightings.

Current Population Trend

The abundance estimates of beaked whales for 1991-1993 were lower than 1994, but there was considerable overlap of the log-normal 95% confidence intervals, which indicates the estimates were not significantly different at that level. Any differences in abundance estimates could be due to chance given the small estimated population size and sampling intensity or a change in distribution, rather than a change in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was not calculated because the minimum population size cannot be calculated.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of beaked whales in the northern Gulf of Mexico is unknown, but there have been no documented reports of fishery-related mortality or serious injury to beaked whales by U.S. fisheries in the Gulf of Mexico. Available information indicates there likely is little, if any, fisheries interaction with beaked whales in the northern Gulf of Mexico.

There were no documented strandings of beaked whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Although PBR cannot be calculated, the total known fishery-related mortality and serious injury for this stock is zero and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant; therefore, this is not a strategic stock.

REFERENCES

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.

Bonde, R. K. and T. J. O'Shea. 1989. Sowerby's beaked whale (Mesoplodon bidens) in the Gulf of Mexico. J. Mammal. 70: 447-449.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Jefferson, T. A., S. Leatherwood, L. K. M. Shoda and R. L. Pitman. 1992. Marine mammals of the Gulf of Mexico: a field guide for aerial and shipboard observers. Texas A&M University Printing Center, College Station, TX. 92 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. NOAA Tech. Rep. NMFS CIRC-396, 176 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Mead, J. G. 1989. Beaked whales of the genus Mesoplodon. Pages 349-430 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, London, 442 pp.

GERVAIS' BEAKED WHALE (*Mesoplodon europaeus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Only three species of *Mesoplodon* are known, from strandings and/or sightings, to have occurred in the Gulf of Mexico (Jefferson et al. 1992; Hansen et al. 1995). These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*), and Sowerby's beaked whale (*M. bidens*). The occurrence of Sowerby's beaked whale in the Gulf of Mexico is considered extralimital because there is only one known stranding of this species in the Gulf of Mexico (Bonde and O'Shea 1989), and because it normally occurs in northern temperate waters of the North Atlantic (Mead 1989). Identification of *Mesoplodon* species at sea is problematic. Therefore, nearly all sightings of these species are identified as beaked whales and may include sightings of *Ziphius cavirostris* which were not identified as such. Beaked whales were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico (Davis et al., in preparation).

Strandings of Gervais' beaked whales have occurred along the northwestern Atlantic coast from Florida to New York (Mead 1989), and there have been at least ten documented strandings of this species in the Gulf of Mexico (Jefferson et al. 1992). There is no information on stock differentiation.

POPULATION SIZE

Estimates of abundance of beaked whales were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Survey effort-weighted estimated average abundance of beaked whales not identified to species for all surveys combined was 117 (coefficient of variation, CV = 0.38) (Hansen et al. 1995). Estimated beaked whale abundance (CV in parentheses) by survey year was 129 in 1991 (0.78),18 in 1992 (1.27), 53 in 1993 (0.78), and 287 in 1994 (0.48) (Hansen et al. 1995). These estimates may also include an unknown number of Cuvier's beaked whales (*Ziphius cavirostris*) and abundance of Gervais' beaked whale cannot be estimated due to uncertainty of species identification at sea.

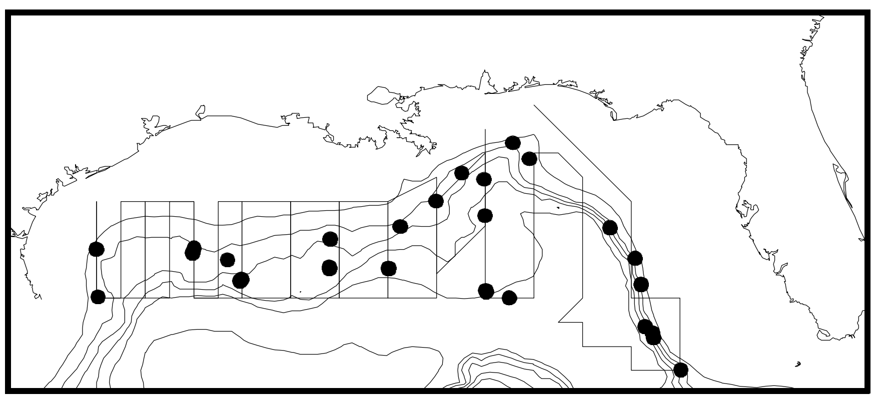


Figure 1. *Distribution of beaked whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

A minimum population estimate could not be not calculated because of uncertainty of species identification of sightings.

Current Population Trend

The abundance estimates of beaked whales for 1991-1993 were lower than 1994, but there was considerable overlap of the log-normal 95% confidence intervals, which indicates the estimates were not significantly different at that level. Any differences in abundance estimates could be due to chance given the small estimated population size and sampling intensity or a change in distribution, rather than a change in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was not calculated because the minimum population size cannot be calculated.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of beaked whales in the northern Gulf of Mexico is unknown, but there have been no documented reports of fishery-related mortality or serious injury to beaked whales by U.S. fisheries in the Gulf of Mexico. Available information indicates there likely is little, if any, fisheries interaction with beaked whales in the northern Gulf of Mexico.

There were no documented strandings of beaked whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Although PBR cannot be calculated, the total known fishery-related mortality and serious injury for this stock is zero and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant; therefore, this is not a strategic stock.

REFERENCES

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.

Bonde, R. K. and T. J. O'Shea. 1989. Sowerby's beaked whale (Mesoplodon bidens) in the Gulf of Mexico. J. Mammal. 70: 447-449.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Jefferson, T. A., S. Leatherwood, L. K. M. Shoda and R. L. Pitman. 1992. Marine mammals of the Gulf of Mexico: a field guide for aerial and shipboard observers. Texas A&M University Printing Center, College Station, 92 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Mead, J. G. 1989. Beaked whales of the genus Mesoplodon. Pages 349-430 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, London, 442 pp.

BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Gulf of Mexico Outer Continental Shelf Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Gulf of Mexico Outer Continental Shelf (OCS) bottlenose dolphin stock is assumed to consist of the shallow, warm water bottlenose dolphin ecotype hypothesized by Hersh and Duffield (1990) inhabiting waters over the U.S. OCS in the northern Gulf of Mexico from approximately 9 km seaward of the 18 m isobath to approximately 9 km seaward of the 183 m isobath and from the U.S.-Mexican border to the Florida Keys. The stock range may extend into Mexican and Cuban territorial waters; however, there are no available estimates of either abundance or mortality from those countries. As a working hypothesis, the bottlenose dolphins inhabiting the 0-18 m depth stratum are believed to constitute coastal stocks in the western, northern, and eastern U.S. Gulf of Mexico separate from the OCS stock; however, the OCS stock may overlap with coastal stocks in some areas and may be genetically indistinguishable from those stocks. The OCS stock may be combined with some or all of the coastal stocks when additional data become available.

In addition, the aerial surveys from which the current abundance estimates were derived overlapped the outer continental shelf edge which is believed to be inhabited by the OCS edge and continental slope stock (Fig. 1). This stock is believed to consist of the deep, cold water ecotype described by Hersh and Duffield for the Atlantic (1990). It is not currently possible to differentiate the two ecotypes visually during aerial surveys.

POPULATION SIZE

Preliminary estimates of abundance were derived using distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during Gulf of Mexico regional aerial line-transect surveys in September-October 1992 and 1993 (Blaylock and Hoggard 1994) and 1994 (NMFS unpublished data). Transects providing systematic coverage of the area and assumed to be randomly placed with respect to bottlenose dolphin distribution extended orthogonally from approximately 9 km past the 18 m isobath to approximately 9 km past the 183 m isobath. Approximately 3.3% of the total area was visually sampled. Preliminary analyses provided a bottlenose dolphin abundance estimate of 50,247 dolphins with coefficient of variation (CV) = 0.18. The survey area overlapped with a portion of the area occupied by the OCS edge and continental slope stock which was assumed to occur in waters over the OCS edge and beyond to the seaward limits of the U.S. Exclusive Economic Zone. This would tend to inflate the abundance estimate, but it is not currently possible to estimate the amount of potential bias.

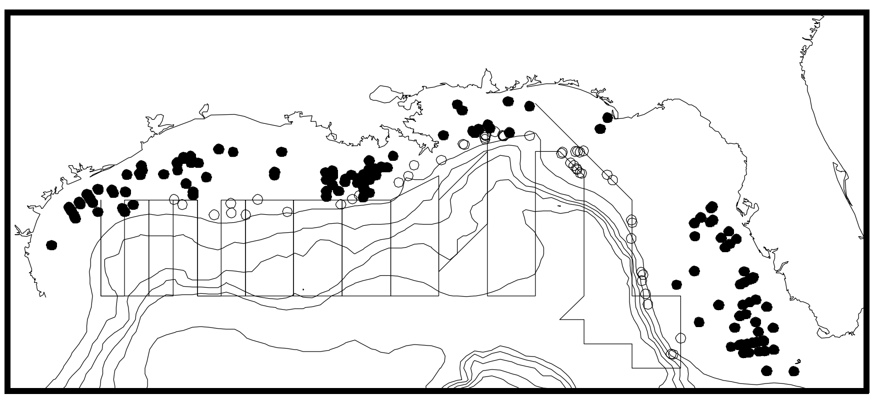


Figure 1. *Sightings of U.S. Gulf of Mexico outer continental shelf (OCS) bottlenose dolphin stock during GOMEX regional aerial surveys (filled circles). Bottlenose dolphin sightings along the OCS edge and continental slope during NOAA Ship Oregon II surveys (unfilled circles), shown for comparison, are believed to be a separate stock. The straight lines show transects during two ship surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population estimate was based on the abundance estimate of 50,247 dolphins (CV = 0.18). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994). The minimum population estimate is 43,233 bottlenose dolphins.

Current Population Trend

The data are insufficient to determine population trends. Aerial surveys conducted during autumn 1983 and 1985 by the Southeast Fisheries Science Center (SEFSC) produced an abundance estimate of 31,519 bottlenose dolphins (CV = 0.08) for this stock (Scott et al. 1989). This population thus appears to have increased from earlier estimated levels; however, a valid statistical comparison of the historical and present estimated population sizes is not presently possible because of the preliminary nature of the recent population size estimate and the possible biases caused by overlap of the survey area with the OCS edge and continental slope stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

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 0.50 because of the stock's status relative to its OSP level is unknown. PBR for this stock is 432 bottlenose dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no observed cases of human-caused mortality and serious injury in this stock; however, based on an observed non-lethal take in U.S. Atlantic waters in 1993 in the pelagic longline fishery, this stock may be subject to incidental take resulting in serious injury or mortality. Fishery interactions have been reported to occur between bottlenose dolphins and the longline swordfish/tuna fishery in the Gulf of Mexico (SEFSC unpublished logbook data) and annual fishery-related mortality and serious injury to bottlenose dolphins is estimated to be 2.8 per year (CV = 0.74) during 1992-1993. This could include bottlenose dolphins from the outer continental shelf edge and continental slope stock.

Total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be 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

Annual fishing effort for the shrimp trawl fishery in the U.S. Gulf of Mexico OCS during 1988-1993 averaged approximately 2.58 million hours of tows (CV = 0.07) (NMFS unpublished data). This fishery was monitored by NMFS observers in 1992 and 1993, but less than 1% of the fishing effort was observed (NMFS unpublished data). There have been no reports of incidental mortality or injury associated with the shrimp trawl fishery in this area.

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery. The following estimates were based on observed takes across the Atlantic longline swordfish/tuna fishery (which includes the Gulf of Mexico). All observed takes were used because the species occurs generally throughout the area of the fishery, but observed takes were infrequent in any given region of the fishery. There were no lethal takes of bottlenose dolphins observed or reported in 1992 and 1993, and only one non-lethal take was reported in 1993, which is assumed to have caused serious injury. The estimated level of fishery-related mortality and serious injury for the entire fishery, including waters outside of the Gulf of Mexico, in 1993 was 16 bottlenose dolphins (CV = 0.19). No take was observed in the Gulf of Mexico, but interactions between bottlenose dolphins and this fishery in the Gulf of Mexico have been reported under the Marine Mammal Protection Act Interim Exemption Program (NMFS 1993).

Given the fact that fishery interactions have been reported to occur between bottlenose dolphins and the longline swordfish/tuna fishery in the Gulf of Mexico, a probable level of fishery-related mortality and serious injury rate can be estimated. Under the assumption that the probability of an incidental take is proportional to fishing effort (number of sets), the estimated level of incidental mortality and serious injury partitioned to include only the Gulf of Mexico stock would be 5.5 bottlenose dolphins in 1993 (CV = 0.19). Average annual fishery-related mortality and serious injury during 1992-1993 would be 2.8 bottlenose dolphins (CV= 0.74). This estimate could include dolphins from the OCS edge and continental slope stock.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration in the Gulf of Mexico.

A trawl fishery for butterfish was monitored by NMFS observers for a short period in the 1980's with no records of incidental take of marine mammals (Burn and Scott 1988; NMFS unpublished data), although an experimental set by NMFS resulted in the death of two bottlenose dolphins (Burn and Scott 1988). There are no other data available.

Other Human-Related Mortality or Serious Injury

The use of explosives to remove oil rigs in the portions of the OCS in the western Gulf of Mexico has the potential to cause serious injury or mortality to marine mammals. These activities have been closely monitored by NMFS observers since 1987 (Gitschlag and Hale, in press) and Gitschlag and Herczeg (in press) described the monitoring activities that occurred in 1992. There have been no reports of either serious injury or mortality to bottlenose dolphins (NMFS unpublished data).

STATUS OF STOCK

The status of this stock relative to OSP is not known and the population trend cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. This is not a strategic stock because fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

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.

Blaylock, R. A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Mem. NMFS-SEFSC-356, 10 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Burn, D. And G. P. Scott. 1988. Synopsis of available information on marine mammal-fisheries interactions in the southeastern United States: preliminary report. NMFS/SEFC, Miami Laboratory, Coastal resources Division, Contribution ML-CRG-87/88-26, 37 pp.

Gitschlag, G. R. and J. K. Hale. In press. Susceptibility of sea turtles to underwater explosives at offshore energy structure removals. Submitted to N. E. Gulf Science.

Gitschlag, G. R. and B. A. Herczeg. In press. Sea turtle observations at explosive removals of energy structures. Submitted to Mar. Fish. Rev.

Hersh, S. L. and D. A. Duffield. 1990. Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. Pages 129-139 *in* S. Leatherwood and R. R. Reeves (editors), The bottlenose dolphin, Academic Press, San Diego, 653 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 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.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Gulf of Mexico Continental Shelf Edge and Continental Slope Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

This bottlenose dolphin stock is defined as the stock which occupies the outer edge of the U.S. Gulf of Mexico Outer Continental Shelf (OCS) and waters over the continental slope within the U.S. Exclusive Economic Zone (EEZ), from the latitude and longitude of the U.S. EEZ off the U.S.-Mexico border to the latitude of the U.S. EEZ south of Key West, Florida. Close observation by experienced NMFS observers from shipboard surveys conducted throughout much of its range (Fig. 1) indicates that most of the dolphins sighted during ship-based surveys over the continental shelf edge and continental slope were the relatively large and robust dolphins assumed to be of the deep water ecotype hypothesized by Hersh and Duffield (1990). These dolphins were reported to be larger and darker in color than bottlenose dolphins seen over the continental shelf closer to shore (NMFS unpublished data). This stock's range may extend into Mexican and Cuban waters; however, there are no estimates available for bottlenose dolphin abundance or mortality from those countries.

POPULATION SIZE

Preliminary estimates of abundance were derived using distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during shipboard line-transect surveys conducted during the spring of 1992-1994 (Fig. 1). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Average bottlenose dolphin abundance over six surveys was estimated at 5,618 dolphins with coefficient of variation (CV) = 0.26. In this analysis, it was assumed that all of the bottlenose dolphins sighted during the ship-based surveys were of this stock. The survey area overlapped in some areas with the OCS stock which was assumed to occur from approximately 9 km seaward of the 18 m isobath to approximately 9 km seaward of the 183 m isobath; however, the amount of overlap is considered insignificant and its effect on the abundance estimate is not known.

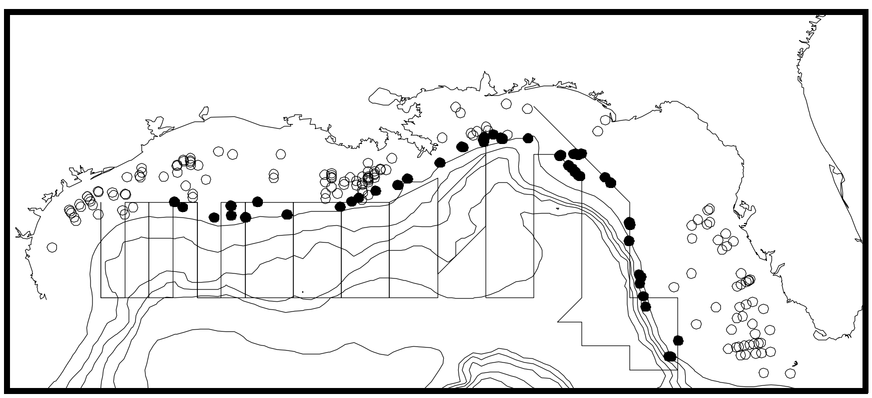


Figure 1. *Distribution of sightings of bottlenose dolphins during NOAA Ship Oregon II marine mammal surveys in the Gulf of Mexico outer continental shelf (OCS) edge and continental slope waters (filled circles). Sightings of the OCS bottlenose dolphin stock made during GOMEX regional aerial surveys (unfilled circles) are shown for comparison. The bottlenose dolphin on the OCS are believed to be a separate stock. The straight lines show transects during two ship surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population estimate was based on the average bottlenose dolphin abundance estimate of 5,618 bottlenose dolphins (CV = 0.26). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994). The minimum population estimate is 4,530 bottlenose dolphins.

Current Population Trend

The data are insufficient to determine population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates for this stock are unknown. The maximum net productivity rate for purposes of this assessment, was assumed to be 0.04. This value 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 (Reilly and Barlow, 1986).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) has been 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). The recovery factor was 0.50 because of the stock's unknown status relative to OSP. PBR for this stock is 45 bottlenose dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no observed cases of human-caused mortality and serious injury in this stock; however, based on an observed non-lethal take in U.S. Atlantic waters in 1993 in the pelagic longline fishery, this stock may be subject to incidental take resulting in serious injury or mortality. Fishery interactions have been reported to occur between bottlenose dolphins and the longline swordfish/tuna fishery in the Gulf of Mexico [Southeast Fisheries Science Center (SEFSC) unpublished logbook data] and annual fishery-related mortality and serious injury to bottlenose dolphins is estimated to be 2.8 per year (CV = 0.74) during 1992-1993. This estimate could include bottlenose dolphins from the OCS stock.

The total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be 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 Interaction

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery. The following estimates were based on observed takes across the Atlantic longline swordfish/tuna fishery (which includes the Gulf of Mexico). All observed takes were used because the species occurs generally throughout the area of the fishery, but observed takes were infrequent in any given region of the fishery. There were no lethal takes of bottlenose dolphins observed or reported in 1992 and 1993, and only one non-lethal take was reported in 1993, which is assumed to have caused serious injury. The estimated level of fishery-related mortality and serious injury for the entire fishery, including waters outside of the Gulf of Mexico, in 1993 was 16 bottlenose dolphins (CV = 0.19). No take was observed in the Gulf of Mexico, but there are logbook reports of interactions between bottlenose dolphins and this fishery (SEFSC unpublished logbook data).

Given the fact that fishery interactions have been reported to occur between bottlenose dolphins and the longline swordfish/tuna fishery in the Gulf of Mexico, a probable level of fishery-related mortality and serious injury rate can be estimated. Under the assumption that the probability of an incidental take is proportional to fishing effort (number of sets), the estimated level of incidental mortality and serious injury partitioned to include only the Gulf of Mexico stock would be 5.5 bottlenose dolphins in 1993 (CV = 0.19). Average annual fishery-related mortality and serious injury during 1992-1993 would be 2.8 bottlenose dolphins (CV= 0.74). This estimate could include dolphins from the OCS stock.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

A trawl fishery for butterfish was monitored by NMFS observers for a short period in the 1980's with no records of incidental take of marine mammals (Burn and Scott 1988; NMFS unpublished data), although an experimental NMFS set resulted in the death of two bottlenose dolphins (Burn and Scott 1988). There are no other data available.

Other Mortality

No direct or indirect human-caused mortality has been reported for this stock.

STATUS OF STOCK

The status of this stock relative to OSP is not known and the population trend cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. This is not a strategic stock because fishery-related mortality or serious injury does not exceed PBR.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Burn, D. And G. P. Scott. 1988. Synopsis of available information on marine mammal-fisheries interactions in the southeastern United States: preliminary report. NMFS/SEFC, Miami Laboratory, Coastal resources Division, Contribution ML-CRG-87/88-26, 37 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Hersh, S. L. and D. A. Duffield. 1990. Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. Pages 129-139 *in* S. Leatherwood and R. R. Reeves (editors), The bottlenose dolphin, Academic Press, San Diego, 653 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 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.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Western Gulf of Mexico Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The western Gulf of Mexico coastal bottlenose dolphin stock has been defined for management purposes as the bottlenose dolphins inhabiting the nearshore coastal waters in the U.S. Gulf of Mexico from the Texas border to the Mississippi River mouth, from shore or presumed bay boundaries to 9.3 km seaward of the 18.3 m isobath (Fig. 1). As a working hypothesis, it is assumed that the dolphins occupying habitats with dissimilar climactic, coastal, and oceanographic characteristics might be restricted in their movements between habitats and, thus, constitute separate stocks. The western coastal area is characterized by an arid to temperate climate, sand beaches, and low fresh water input. The northern coastal stock area which is characterized by a temperate climate, barrier islands, sand beaches, coastal marshes and marsh islands, and has a relatively high level of fresh water input from rivers and streams. The eastern coastal stock area is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches, marsh and mangrove islands, and has an intermediate level of freshwater input.

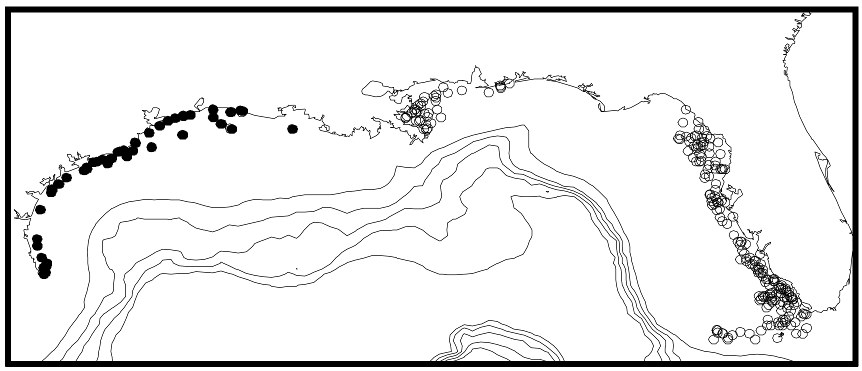


Figure 1. *Sightings of coastal bottlenose dolphins during GOMEX aerial surveys of the Gulf of Mexico in 1992-1994. Western Gulf of Mexico coastal bottlenose dolphin stock is shown with filled circles. Isobaths are in 183 m (100 fm) intervals.*

The stock occurs trans-boundary with Mexico; however, there is no information available for abundance estimation, nor for estimating fishery-related mortality in Mexican waters. The ratio of DDE to DDT was extraordinarily high in tissues of one bottlenose dolphin stranded on the Texas coast (Varanasi et al. 1992), suggesting recent exposure to DDT which is still in use in Mexico.

The Mississippi River outflow may constitute an effective ecological barrier to stock migration at the eastern boundary. This assumption has not been tested and interbreeding may, in fact, occur between this and the northern coastal stock at this boundary; therefore, the definition of this stock may be revised and the stock may be incorporated with the northern coastal stock when more data become available. There are data which suggest that there is considerable longshore movement by some members of the western coastal stock (NMFS unpublished data), but the extent of this movement is unknown.

Some of this stock may co-occur with the resident bay, sound, and estuarine stocks, and breeding may occur among these stocks. For instance, two bottlenose dolphins previously seen in the South Padre Island area in Texas were seen in Matagorda Bay, 285 km north, in May 1992 and May 1993 (Lynn 1995). These sightings suggest that some bay stocks dolphins occasionally traverse the coastal stock area.

Portions of this stock may co-occur with the U.S. Gulf of Mexico outer continental shelf (OCS) stock. The seaward boundary for this stock corresponds to aerial survey strata (NMFS unpublished data) and thus, represents a management boundary rather than an ecological boundary. Anecdotal evidence suggests that both the coastal and OCS stocks consist of the shallow, warm water ecotype described by Hersh and Duffield (1990). Data are not currently available to determine genetically if the two stocks should be separated or, if so, where; and interbreeding may occur at the boundary interface.

POPULATION SIZE

Preliminary abundance estimates were derived using distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during aerial line-transect surveys in September-October 1992 (Blaylock and Hoggard 1994). Sampling transects extended orthogonally from shore out to approximately 9 km past the 18 m isobath. The 1992 coastal survey area extended from the U.S. -Mexican border to the Mississippi River mouth. Systematic transects were placed randomly with respect to bottlenose dolphin distribution and provided approximately 5% visual coverage of the survey area. Bottlenose dolphin abundance was estimated to be 3,499 dolphins (CV = 0.21) (Blaylock and Hoggard 1994).

Minimum Population Estimate

The minimum population estimate was based on the1992 abundance estimate of 3,499 bottlenose dolphins (CV = 0.21) (Blaylock and Hoggard 1994). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994). The minimum population estimate is 2,938 bottlenose dolphins.

Current Population Trend

Aerial surveys of this area conducted by NMFS in autumn 1983 resulted in an estimated bottlenose dolphin abundance of 4,718 (CV = 0.10). The data are not sufficient to conduct a statistical trend analysis, but the current population size estimate is significantly lower than the 1983 estimate (Student's t-test, $P < 0.001$) and suggests a decline in stock abundance.

This stock was subject to higher than usual mortality levels in 1990, 1992, and 1993-94, and the incidence of bottlenose dolphin strandings along the Texas coast in those years was significantly higher than the 1984-94 mean stranding rate (Southeast U.S. Marine Mammal Stranding Network unpublished data). Some of these mortalities may have been related to accumulation of anthropogenic hydrocarbon contaminants. A recent study indicated an inverse relationship between hydrocarbon contaminant levels and certain bacterial and viral antigen titers in bottlenose dolphins from Matagorda Bay, Texas (Reif et al., in preparation).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) has been 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 size (OSP). The recovery factor was set at 0.50 because of the stock's unknown status relative to optimum sustainable population levels, because of an undetermined level of fishery-related mortality, and because of the recent occurrence of three anomalous mortality events. PBR for this stock is 29 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of direct human-caused mortality in this stock is unknown. An annual mean of 13 (CV = 0.46) bottlenose dolphins stranded on the Texas coast during the period 1988-1993, showing signs of fishery interactions such as net entanglement, mutilation, gunshot wounds, etc. (Southeast U.S. Marine Mammal Stranding Network unpublished data). This was 10.3% of the total bottlenose dolphin strandings reported for this area.

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a bay, sound or estuarine stock; however, the proportion of the stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

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 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.

Fisheries Information

Annual fishing effort for the shrimp trawl fishery in the western Gulf of Mexico coastal stock area during 1988-1993 averaged approximately 0.35 million hours of tows (CV = 0.16) (NMFS unpublished data). This fishery was monitored by NMFS observers in 1992 and 1993, but less than 1% of the fishing effort was observed (NMFS unpublished data). There have been no reports of incidental mortality or injury in the western Gulf of Mexico coastal bottlenose dolphin stock associated with the shrimp trawl fishery in this area.

The menhaden purse seine fishery targets the Atlantic menhaden, *Brevortia tyrannus*, in Gulf of Mexico coastal waters approximately 3-18 m in depth (NMFS 1991). Seventy-five menhaden vessels operate within 1.6 km of shore from Apalachicola, Florida to Freeport, Texas, from April-October. Lethal takes of bottlenose dolphins reported by the menhaden fishery during the period 1982-1988 ranged between 0-4 dolphins annually (NMFS unpublished data).

Gillnets are not used in Texas, and gillnets over 46 m^3 in area will not be allowed in Florida past July 1995, but fixed and runaround gillnets are currently in use in Louisiana, Mississippi, and Alabama. These fisheries, for the most part, operate year around. They are state-controlled and licensed, and vary widely in intensity and target species. No marine mammal mortalities associated with gillnet fisheries have been reported in these states, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury.

The fishery for blue crabs operates in estuarine areas throughout the Gulf coast employing traps attached to a buoy with rope. Bottlenose dolphins have been reported stranded in Mississippi with polypropylene rope around their flukes indicating the possibility of entanglement with crab pot lines (NMFS 1991); however, this fishery has not been monitored by observers.

Two bottlenose dolphins were entangled and died in a scientific research net fishery for sea turtles in Sabine Pass in 1993 (A. Landry, Texas A&M University, report to Texas Marine Mammal Stranding Network, August 1993). The nets used in this Endangered Species Act (ESA) permitted research activity were two 4.9 m deep x 91.5 m in length stationary entanglement nets adjacent to each other. They were fished in shallow water (0.9-2.5 m depth), monitored continuously throughout the day, and removed at night.

Other Mortality

The coast adjacent to the nearshore habitat occupied by this stock varies from agricultural to industrial and, in some places, such as Galveston Island, is dense in human population. Concentrations of chlorinated hydrocarbons and metals were relatively low in most of the bottlenose dolphins examined in conjunction with an anomalous mortality event in Texas bays in 1990; however, some had concentrations at levels of possible toxicological concern (Varanasi et al. 1992). Agricultural runoff following periods of high rainfall in 1992 was implicated in a high level of bottlenose dolphin mortalities in Matagorda Bay, which is adjacent to the western coastal stock area (NMFS unpublished data).

A recent study of hydrocarbon contaminant levels was conducted in conjunction with a health assessment study of 35 live-captured bottlenose dolphins in Matagorda Bay which adjoins the coastal stock area. Alpha-HCB, p,p,DDE, and PCB concentrations were inversely related to the magnitude of the serum antibody titer to *Erysipelas* spp. and *Staphylococcus* spp. bacteria (Reif et al., in preparation.). A similar and more pronounced trend was seen in relationship to the pseudorabies virus; however, since pseudorabies virus is not known to infect bottlenose dolphins, the significance of this finding is not clear. Concentrations of contaminants were higher in dolphins having evidence of exposure to the cetacean morbillivirus. The reason for the difference in the relationship between antibody titers to bacteria and pseudorabies and antibody titers to cetacean morbillivirus is not understood.

STATUS OF STOCK

The status of this stock relative to OSP is unknown. A population trend analysis is not available due to insufficient information. This species is not listed as threatened or endangered under the ESA. The occurrence of three anomalous mortality events among bottlenose dolphins along the Texas coast since 1990 (NMFS unpublished data) is cause for concern and the available evidence suggests that bottlenose dolphin stocks in the northern and western portion of the U.S. Gulf of Mexico may have experienced a morbillivirus epidemic in 1993 (Lipscomb 1993); however, the effects of these events on stock abundance has yet to be determined. This is not a strategic stock because the known level of fishery-related mortality or serious injury does not exceed PBR.

REFERENCES

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.

Blaylock R. A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Mem. NMFS-SEFSC-356, 10 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Hersh, S. L. and D. A. Duffield. 1990. Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. Pages 129-139 *in* S. Leatherwood and R. R. Reeves (editors), The bottlenose dolphin, Academic Press, San Diego, 653 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Lipscomb, T. P. 1993. Some answers to questions about morbillivirus. Pages 4-5 *in* R. A. Blaylock, B. Mase, and D. K. Odell (editors), Strandings - Newsletter of the Southeast U.S. Marine Mammal Stranding Network, Vol. 2 No. 3, Southeast Fisheries Science Center, Miami Laboratory, Miami, Florida, 8 pp.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement. June 1991.

Reif, J. S., L. J. Hansen, S. Galloway, G. Mitchum, T. L. Schmitt. In preparation. The relationship between chlorinated hydrocarbon contaminants and selected health parameters in bottlenose dolphins (*Tursiops truncatus*) from Matagorda Bay, Texas, 1992. Colorado State University, Fort Collins, and NMFS, Southeast Fisheries Science Center, Miami, Florida.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

Varanasi, U., K. L. Tilbury, D. W. Brown, M. M. Krahn, C. A. Wigren, R. C. Clark, and S-L. Chan. 1992. Pages 56-86 *in* L. J. Hansen (editor), Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings, Southeast Fisheries Science Center Contribution MIA-92/93-21, 219 pp.

BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Northern Gulf of Mexico Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The northern Gulf of Mexico coastal bottlenose dolphin stock has been defined for management purposes as those bottlenose dolphins occupying the nearshore coastal waters in the U.S. Gulf of Mexico from the Mississippi River mouth to approximately 84º W longitude, from shore, barrier islands, or presumed bay boundaries to 9.3 km seaward of the 18.3 m isobath (Fig. 1). As a working hypothesis, it is assumed that the dolphins occupying habitats with dissimilar climactic, coastal, and oceanographic characteristics might be restricted in their movements between habitats and, thus, constitute separate stocks. The northern coastal stock area is characterized by a temperate climate, barrier islands, sand beaches, coastal marshes and marsh islands, and has a relatively high level of fresh water input from rivers and streams. It is bordered on the east by an extensive area of coastal marsh and marsh islands typical of Florida's Apalachee Bay. The western coastal area is characterized by an arid to temperate climate, sand beaches, and low fresh water input. The eastern coastal stock area is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches, marsh and mangrove islands, and has an intermediate level of freshwater input.

Figure 1. *Sightings of coastal bottlenose dolphins during GOMEX aerial surveys of the Gulf of Mexico in 1992-1994. Northern Gulf of Mexico coastal bottlenose dolphin stock is shown with filled circles. Isobaths are in 183 m (100 fm) intervals.*

The definition of this stock may be changed and it may be incorporated with other Gulf of Mexico stocks when more data become available. Seasonal changes in bottlenose dolphin abundance in Mississippi Sound (NMFS unpublished data) suggests that there is interchange with at least that portion of the Gulf of Mexico bay and sound stocks; however, its extent and significance is not presently known. Portions of this stock may co-occur with the U.S. Gulf of Mexico outer continental shelf (OCS) stock. The seaward boundary for this stock corresponds to aerial survey strata (NMFS unpublished data) and thus, represents a management boundary rather than an ecological boundary. Anecdotal evidence suggests that both the coastal and OCS stocks consist of the shallow, warm water ecotype described by Hersh and Duffield (1990). Data are not currently available to determine genetically if the stocks should be separated or, if so, where; and interbreeding may occur at the boundary interface.

POPULATION SIZE

Preliminary estimates of abundance were derived using distance sampling analysis (Buckland et al.1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during aerial line-transect surveys in September-October 1993 (Blaylock and Hoggard 1994). Systematic sampling transects, placed randomly with respect to the bottlenose dolphin distribution, extended orthogonally from shore out to approximately 9 km past the 18 m isobath. The area surveyed extended from the Mississippi River mouth to approximately 84º W Longitude, and approximately 5% of the total area was visually searched. Bottlenose dolphin abundance was estimated to be 4,191 dolphins with coefficient of variation (CV) = 0.21 (Blaylock and Hoggard 1994).

Minimum Population Estimate

The minimum population estimate was based on the 1993 abundance estimate of 4,191 dolphins (CV = 0.21) (Blaylock and Hoggard 1994). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994). The minimum population estimate is 3,518 bottlenose dolphins.

Current Population Trend

Aerial surveys of this area conducted partly in autumn 1983 and partly in autumn 1985, by NMFS resulted in an estimated bottlenose dolphin abundance of 1,319 (CV = 0.10). The data are not sufficient to conduct a statistical trend analysis, but the current population size estimate is significantly higher than the 1983-85 estimate (Student's t-test, $P < 0.005$).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates for this stock are unknown. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) has been 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 size (OSP). The recovery factor was set at 0.50 because of the stock's unknown status relative to optimum sustainable population levels, because the stock apparently sustains some unknown level of fishery-related mortality, and because of the unknown effects of the 1993 mortality event. PBR for this stock is 35 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of direct human-caused mortality in this stock is unknown. An annual average of ten bottlenose dolphins (CV = 0.41) stranded on the coast of Louisiana, Mississippi, or Alabama during the period 1988-1993, showing signs of fishery interactions such as net entanglement, mutilation, gunshot wounds, etc. (Southeast U.S. Marine Mammal Stranding Network unpublished data). This was 8.2% of the total bottlenose dolphin strandings reported for this area. There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a bay, sound or estuarine stock; however, the proportion of the stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total fishery-related mortality and serious injury for this stock is unknown, but considering the evidence from stranding data, it may not be less than 10% of the calculated PBR and, therefore, cannot be considered to be 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.

Fisheries Information

Annual fishing effort for the shrimp trawl fishery in the northern Gulf of Mexico coastal stock area during 1988-1993 averaged approximately 2.17 million hours of tows (CV = 0.13) (NMFS unpublished data). This fishery was monitored by NMFS observers in 1992 and 1993, but less than 1% of the fishing effort was observed (NMFS unpublished data). There have been no reports of incidental mortality or injury in the northern Gulf of Mexico coastal bottlenose dolphin stock associated with the shrimp trawl fishery in this area.

The menhaden purse seine fishery targets the Atlantic menhaden, *Brevortia tyrannus*, in Gulf of Mexico coastal waters approximately 3-18 m in depth (NMFS 1991). Seventy-five menhaden vessels operate within 1.6 km of shore from Apalachicola, Florida to Freeport, Texas, from April-October. Lethal takes of bottlenose dolphins reported by the menhaden fishery during the period 1982-1988 ranged between 0-4 dolphins annually (NMFS unpublished data).

Other clupeid purse seiners opportunistically target Spanish sardine, thread herring, ladyfish, cigarfish, and blue runners. Single boat purse seiners, fishing for sardines and herrings, operate in coastal waters between the Mississippi River delta and Pascagoula, Mississippi and in the Florida panhandle between Pensacola and Apalachicola. It is estimated that ten vessels participate in this fishery between May-October. There are no estimates of dolphin mortality associated with this fishery.

Gillnets are not used in Texas, and gillnets over 46 m^3 in area will not be allowed in Florida past July 1995, but fixed and runaround gillnets are currently in use in Louisiana, Mississippi, and Alabama. These fisheries, for the most part, operate year around. They are state-controlled and licensed, and vary widely in intensity and target species. No marine mammal mortalities associated with gillnet fisheries have been reported in these states, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury.

The fishery for blue crabs operates in estuarine areas throughout the Gulf coast employing traps attached to a buoy with rope. Bottlenose dolphins have been reported stranded in Mississippi with polypropylene rope around their flukes indicating the possibility of entanglement with crab pot lines (NMFS 1991); however, this fishery has not been monitored by observers.

Other Mortality

The nearshore habitat occupied by this stock is adjacent to areas of high human population. Two stranded dolphins from the northern Gulf coastal area (one from Mississippi and one from Alabama) had the highest levels of DDT derivatives of any of the bottlenose dolphin liver samples analyzed in conjunction with the 1990 mortality investigation conducted by NMFS (Varanasi et al. 1992). The significance of these findings are unclear, but there is some evidence that increased exposure to anthropogenic compounds may reduce immune function in bottlenose dolphins. A recent study found the magnitude of the serum antibody titer to *Erysipelas* spp. and *Staphylococcus* spp. bacteria in bottlenose dolphins was inversely related to á-HCB, p,p,DDE, and PCB's concentrations (Reif et al., in preparation).

This stock was subject to a high incidence of mortality in 1993, which was suspected to have been the result of a morbillivirus epidemic. The effect of this mortality event on the stock cannot be determined, in part, because the mortality may have also affected the bay, sound and estuarine stock and the stock identity of the stranded animals could not be determined. The increase in mortalities began in the Florida panhandle area and moved westward during that period (NMFS unpublished data). Concentrations of contaminants were found to be higher in dolphins having evidence of exposure to the cetacean morbillivirus (Reif et al., in preparation). The reason for the relationship between cetacean morbillivirus antibody titers and high contaminant levels is not understood and the effect of the epidemic on this stock has not been determined.

STATUS OF STOCK

The status of this stock relative to OSP is not known and population trends cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. This is not a strategic stock because the known level of fishery-related mortality or serious injury does not exceed PBR.

REFERENCES

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.

Blaylock, R. A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Mem. NMFS-SEFSC-356, 10 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Hersh, S. L. and D. A. Duffield. 1990. Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. Pages 129-139 *in* S. Leatherwood and R. R. Reeves (editors), The bottlenose dolphin, Academic Press, San Diego, 653 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Lipscomb, T. P. 1993. Some answers to questions about morbillivirus. Pages 4-5 *in* R. A. Blaylock, B. Mase, and D. K. Odell (editors), *Strandings* - Newsletter of the Southeast U.S. Marine Mammal Stranding Network, Vol. 2 No. 3, Southeast Fisheries Science Center, Miami Laboratory, Miami, Florida, 8 pp.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement. June 1991.

Reif, J. S., L. J. Hansen, S. Galloway, G. Mitchum, T. L. Schmitt. In preparation. The relationship between chlorinated hydrocarbon contaminants and selected health parameters in bottlenose dolphins (*Tursiops truncatus*) from Matagorda Bay, Texas, 1992. Colorado State University, Fort Collins, and NMFS, Southeast Fisheries Science Center, Miami, Florida.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Eastern Gulf of Mexico Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The eastern Gulf of Mexico coastal bottlenose dolphin stock has been defined for management purposes as the bottlenose dolphins occupying the area which extends from approximately 84º W Longitude to Key West, Florida, from shore, barrier islands, or presumed bay boundaries to 9.3 km seaward of the 18.3 m isobath (Fig. 1). As a working hypothesis, it is assumed that the dolphins occupying habitats with dissimilar climactic, coastal, and oceanographic characteristics might be restricted in their movements between habitats and, thus, constitute separate stocks. The eastern coastal stock area is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches, marsh and mangrove islands, and has an intermediate level of freshwater input. It is bordered on the north by an extensive area of coastal marsh and marsh islands typical of Florida's Apalachee Bay. The western coastal area is characterized by an arid to temperate climate, sand beaches, and low fresh water input. The northern coastal stock area is characterized by a temperate climate, barrier islands, sand beaches, coastal marshes and marsh islands, and has a relatively high level of fresh water input from rivers and streams.

Figure 1. *Sightings of coastal bottlenose dolphins during GOMEX aerial surveys of the Gulf of Mexico in 1992-1994. Eastern Gulf of Mexico coastal bottlenose dolphin stock is shown with filled circles. Isobaths are in 183 m (100 fm) intervals.*

Portions of this stock may co-occur with the U.S. Gulf of Mexico outer continental shelf (OCS) stock. The seaward boundary for this stock corresponds to aerial survey strata (NMFS unpublished data) and thus, represents a management boundary rather than an ecological boundary. Anecdotal evidence suggests that both the coastal and OCS stocks consist of the shallow, warm water ecotype described by Hersh and Duffield (1990). Data are not currently available to determine genetically if the two stocks should be separated or, if so, where; and interbreeding may occur at the boundary interface.

POPULATION SIZE

Preliminary estimates of abundance were derived using distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during aerial line-transect surveys conducted during autumn 1994 (NMFS unpublished data). Systematic sampling transects, placed randomly with respect to the bottlenose dolphin distribution, extended orthogonally from shore out to approximately 9 km past the 18 m isobath. Approximately 5% of the total survey area was visually searched. Bottlenose dolphin abundance was estimated to be 9,912 dolphins with coefficient of variation (CV) = 0.12.

Minimum Population Estimate

The minimum population estimate was based on the 1994 abundance estimate of 9,912 (CV = 0.12) (NMFS unpublished data). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution as specified by NMFS (Anon. 1994). The minimum population estimate is 8,963 bottlenose dolphins.

Current Population Trend

Aerial surveys of this area conducted by NMFS in autumn 1985, resulted in an estimated bottlenose dolphin abundance of 4,711 (CV = 0.05). The data are not sufficient to conduct a statistical trend analysis, but the current population size estimate is significantly higher than the 1985 estimate (Student's t-test, $P < 0.0005$).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) has been 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 size (OSP). The recovery factor was set at 0.50 because of the stock's unknown status relative to OSP. PBR for this stock is 90 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of direct human-caused mortality in this stock is unknown. An annual mean of eight bottlenose dolphins (CV = 0.41) stranded on the Florida Gulf coast during the period 1988-1993, showing signs of fishery interactions such as net entanglement, mutilation, gunshot wounds, etc. (Southeast U.S. Marine Mammal Stranding Network unpublished data). This was 8.9% of the total bottlenose dolphin strandings reported for this area. Morgan and Patton (1990) reported that 12.9% of 116 cetaceans examined by Mote Marine Laboratory's marine mammal stranding response program on the west coast of Florida between 1984 and 1990 exhibited evidence of human-caused mortality or serious injury.

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a bay, sound or estuarine stock; however, the proportion of the stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be 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.

Fisheries Information

Annual fishing effort for the shrimp trawl fishery in the eastern Gulf of Mexico coastal stock area during 1988-1993 averaged approximately 0.102 million hours of tows (CV = 0.30) (NMFS unpublished data). This fishery was monitored by NMFS observers in 1992 and 1993, but less than 1% of the fishing effort was observed (NMFS unpublished data). There was one report in 1992 of an incidental mortality in the eastern Gulf of Mexico coastal bottlenose dolphin stock which was associated with the shrimp trawl fishery in this area.

Gillnets are not used in Texas, and gillnets over 46 m^3 in area will not be allowed in Florida past July 1995, but fixed and runaround gillnets are currently in use in Louisiana, Mississippi, and Alabama. These fisheries, for the most part, operate year around. They are state-controlled and licensed, and vary widely in intensity and target species. No marine mammal mortalities associated with gillnet fisheries have been reported in these states, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury. A coastal gillnet fishery for menhaden was reported to have taken one bottlenose dolphin in 1991 (NMFS unpublished data). There are no effort data available for this fishery.

The menhaden purse seine fishery targets the Atlantic menhaden, *Brevortia tyrannus*, in Gulf of Mexico coastal waters approximately 3-18 m in depth (NMFS 1991). Seventy-five menhaden vessels operate within 1.6 km of shore from Apalachicola, Florida to Freeport, Texas, from April-October. Lethal takes of bottlenose dolphins reported by the menhaden fishery during the period 1982-1988 ranged between 0-4 dolphins annually (NMFS unpublished data).

Other clupeid purse seiners opportunistically target Spanish sardine, thread herring, ladyfish, cigarfish, and blue runners. There are no effort data available for this fishery and there are no estimates of dolphin mortality associated with this fishery.

A fishery for blue crabs operates in estuarine areas throughout the Gulf coast employing traps attached to a buoy with rope. Bottlenose dolphins have been reported stranded in other coastal locations in the Gulf of Mexico with polypropylene rope around their flukes indicating the possibility of entanglement with crab pot lines (NMFS 1991); however, this fishery has not been monitored by observers.

Other Mortality

The nearshore habitat occupied by this stock is adjacent to areas of high human population and in some areas of Florida, such as the Tampa Bay area, is highly industrialized. PCB concentrations in three stranded dolphins sampled from this stock ranged from 16-46 μg/g wet weight. Concentrations of á-HCB, p,p,DDE, and PCB's were inversely related to the magnitude of the serum antibody titer to *Erysipelas* spp. and *Staphylococcus* spp. bacteria in a study of bottlenose dolphins in Texas (Reif et al., in preparation). A similar and more pronounced trend was seen in relationship to the pseudorabies virus; however, since pseudorabies virus is not known to infect bottlenose dolphins, the significance of this finding is not clear. Concentrations of contaminants were higher in dolphins having evidence of exposure to the cetacean morbillivirus. The reason for the difference in the relationship between antibody titers to bacteria and pseudorabies and antibody titers to cetacean morbillivirus is not understood.

STATUS OF STOCK

The status of this stock relative to OSP is not known and population trends cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. This is not a strategic stock because the known level of fishery-related mortality or serious injury does not exceed PBR.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Morgan, M. A. and G. W. Patton. 199 0. Human dolphin interactions on the west coast of Florida: Documentation from MML's marine mammal response program. MML Technical Report #191, 9 pp.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement. June 1991.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Gulf of Mexico Bay, Sound, and Estuarine Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

Studies relying on identification of individual dolphins (Scott et al. 1990; Wells 1986a) suggest that bottlenose dolphins inhabiting many of the bays, sounds, and other estuaries adjacent to the Gulf of Mexico form discrete communities. Although breeding may occur between adjacent communities, the geographic nature of these areas suggests that each community exists as a functioning unit of its ecosystem and, under the Marine Mammal Protection Act, must be maintained as such. Therefore, each of those areas forming a contiguous, enclosed or semi-enclosed body of water is considered to contain a distinct bottlenose dolphin stock and will be reported as such within this report. However, because there are insufficient data currently available with which to evaluate fisheries within each area, a separate stock assessment report will not be prepared for each local stock at this time.

Mark-recapture studies using photo-identification of individual dolphins in the vicinity of Sarasota and Tampa Bays in Florida showed that individual dolphins remained in a given area year around (Scott et al. 1990). Wells (1986a) described three distinct dolphin "communities" in the area in and around Sarasota Bay. One community was formed by dolphins residing in the Gulf of Mexico coastal waters, another consisted of the dolphins in the deep water areas of Passage Key Inlet and Tampa Bay (adjacent to Sarasota Bay), and a third community resided in the shallow waters of Sarasota Bay. Electrophoretic isozyme analysis showed significant differences between dolphins of the shallow water Sarasota community and the Tampa Bay community, and from dolphins from Charlotte Harbor, to the south; however, there was a high degree of genetic heterozygosity indicating that the Sarasota community was not genetically isolated (Duffield and Wells 1986). Wells (1986b) suggested that the Sarasota community is likely one of a number of communities which comprise a population, the limits of which are unknown. He suggested that the continuous distribution of bottlenose dolphins around the Gulf of Mexico coast theoretically allows genetic exchange between adjacent communities; however, he also noted that the females of the highly-structured Sarasota community form a stable, discrete, long-term breeding unit with strong geographical fidelity (Wells 1986b). Depletion of a bottlenose dolphin community within a restricted geographical area could have a deleterious effect on its ability to recover. Conservative management practice dictates that such a community be treated as a stock for managing interactions with fisheries.

Recent photo-identification and radio-tracking studies confirmed that some individuals remained in the same general areas within Matagorda Bay, Texas, throughout the year (Lynn 1995); thus, the situation there may be similar to that of the Florida west coast. Movement by resident bottlenose dolphins in Texas through passes linking bays with the Gulf of Mexico appears to be relatively limited (Shane 1977; Gruber 1981; McHugh 1989; Lynn 1995), but it apparently does occur and these stocks may not be reproductively isolated from the coastal stocks. Two bottlenose dolphins previously seen in the South Padre Island, Texas, coastal area were seen in Matagorda Bay, 285 km north, in May 1992 and May 1993 (Lynn 1995). Preliminary analyses of MtDNA using polymerase chain reaction procedures suggested that Matagorda Bay dolphins appear to be a localized population (NMFS unpublished data). Over 1,000 individual bottlenose dolphins have been identified in bay and coastal waters near the northeast end of Galveston Island, Texas (Bräger et al. 1994; Bräger 1992, 1993; Henningsen 1991), but most of these were sighted only once and approximately 200 individuals were reported to use the area over the long term (Bräger et al. 1994).

Much less is known about the movements of resident bottlenose dolphins in estuaries of the northern Gulf of Mexico. There are observed seasonal differences in bottlenose dolphin abundance in Mississippi Sound that suggest seasonal migration (NMFS unpublished data); however, the spatial migration patterns are not currently known. It appears probable that some exchange occurs between the Mississippi Sound stock and the coastal stock in this area. Additional information may result in the future combining of these stocks in this area.

POPULATION SIZE

Population size (Table I) for all of the stocks except Sarasota Bay, Florida, was estimated from preliminary analyses of line-transect data collected during aerial surveys conducted in September-October 1992 in Texas and Louisiana, in September-October 1993 in Louisiana, Mississippi, Alabama, and the Florida panhandle (Blaylock and Hoggard 1994), and aerial surveys of the west coast of Florida in September-November 1994 (NMFS unpublished data). Standard line transect perpendicular sighting distance analytical methods were used (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993). Stock size in Sarasota Bay, Florida, was obtained through direct count of known individuals (Wells 1992).

Minimum Population Estimate

The minimum population estimate (Table I) is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distribution specified by NMFS (Anon. 1994). The minimum population estimate was calculated for each block from the estimated population size and its associated coefficient of variation. Where the population size resulted from a direct count of known individuals, the minimum population size was identical to the estimated population size.

Table I. *Bottlenose dolphin abundance (N_{BEST}), coefficient of variation (CV), minimum population estimate (N_{MIN}), and Potential Biological Removal (PBR) in U.S. Gulf of Mexico bays, sounds, and other estuaries. Blocks refer to aerial survey blocks illustrated in Fig. 1.*

Notes: [1]Bottlenose dolphins not sighted during earlier surveys (Scott et al. 1989). [2]Block not surveyed during surveys reported in Blaylock and Hoggard (1994). [3]No CV because N_{BEST} was a direct count of known individuals.

Blocks	Gulf of Mexico Estuary	N_{BEST}	CV	N_{MIN}	PBR	Year	Reference
B51	Laguna Madre	80	1.57	31	0.3	1992	Blaylock and Hoggard 1994
B52	Nueces Bay, Corpus Christi Bay	58	0.61	36	0.4	"	"
B50	Compano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espirito Santo Bay	55	0.82	30	0.3	"	"
B54	Matagorda Bay, Tres Palacios Bay, Lavaca Bay	61	0.45	42	0.4	"	"
B55	West Bay	29	1.10	14	0.1	"	"
B56	Galveston Bay, East Bay, Trinity Bay	152	0.43	107	1.1	"	"
B57	Sabine Lake	0	—	0	0.0	"	"
B58	Calcasieu Lake	0	—	0	0.0	"	"
B59	Vermillion Bay, West Cote Blanche Bay, Atchafalaya Bay	0 [1]	—	0	0.0	"	"
B60	TerreBonne Bay, Timbalier Bay	100	0.53	66	0.7	1993	"
B61	Barataria Bay	219	0.55	142	1.4	"	"
B30	Mississippi River Delta	0 [1]	—	0	0.0	"	"
B02-05,29,31	Bay Boudreau, Mississippi Sound	1,401	0.13	1,256	13	"	"
B06	Mobile Bay, Bonsecour Bay	122	0.34	92	0.9	"	"
B07	Perdido Bay	0 [1]	—	0	0.0	"	"
B08	Pensacola Bay, East Bay	33	0.80	18	0.2	"	"
B09	Choctawhatchee Bay	242	0.31	188	1.9	"	"
B10	St. Andrew Bay	124	0.57	79	0.8	"	"
B11	St. Joseph Bay	0	—	0	0.0	"	"
B12-13	St. Vincent Sound, Apalachicola Bay, St. Georges Sound	387	0.34	293	2.9	"	"
B14-15	Apalachee Bay	491	0.39	358	3.6	"	"
B16	Waccasassa Bay, Withlacoochee Bay, Crystal Bay	100	0.85	54	0.5	1994	"
B17	St. John's Sound, Clearwater Harbor	37	1.06	18	0.2	"	"
B32-34	Tampa Bay	559	0.24	458	4.6	"	"
B20	Sarasota Bay	97	na [3]	97	1.0	1992	Wells 1992
B35	Little Sarasota Bay	2 [2]	0.24	2	0.0	1985	Scott et al. 1989
B21	Lemon Bay	0 [1]	—	0	0.0	1994	Blaylock and Hoggard 1994
B22-23	Pine Sound, Charlotte Harbor, Gasparilla Sound	209	0.38	153	1.5	"	"
B36	Caloosahatchee River	0 [1,2]	—	0	0.0	1985	Scott et al. 1989
B24	Estero Bay	104	0.67	62	0.6	1994	Blaylock and Hoggard 1994
B25	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	208	0.46	144	1.4	"	"
B27	Whitewater Bay	242	0.37	179	1.8	"	"
B28	Florida Keys (Bahia Honda Key to Key West)	29	1.00	14	0.1	"	"

Current Population Trend

The data are insufficient to determine population trends. Three anomalous mortality events have occurred among portions of this stock between 1990 and 1994; however, it is not possible to accurately partition the mortalities between the bay and coastal stocks, thus the impact of these mortality events on these stocks is not known.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value 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 (Reilly and Barlow 1986).

POTENTIAL BIOLOGICAL REMOVAL

PBR has been specified as the product of minimum population size, one-half the maximum productivity rate,

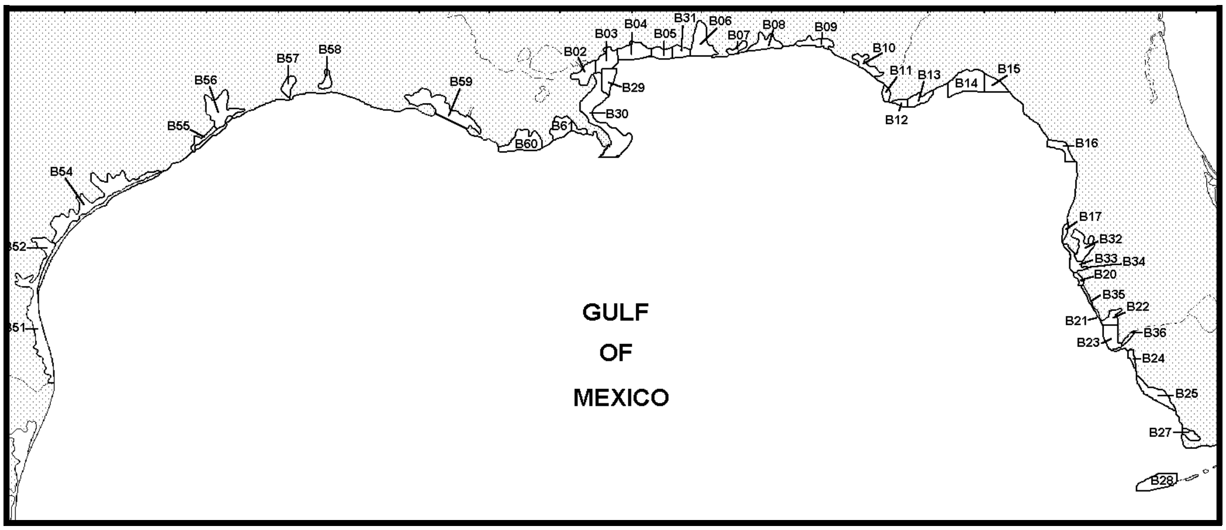


Figure 1. *U.S. Gulf of Mexico bays and sounds. Each of the alpha-numerically designated blocks corresponds to one of the NMFS Southeast Fisheries Science Center logistical aerial surveys areas listed in Table I. The bottlenose dolphins inhabiting each bay and sound are considered to comprise a unique stock for purposes of this assessment.*

and a "recovery" factor for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population size (OSP). The recovery factor was 0.50 because of the stocks' unknown status relative to OSP. PBR for each stock is given in Table I.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

An annual mean of 30 bottlenose dolphins with coefficient of variation (CV) = 0.21 stranded on the coast in the U.S. Gulf of Mexico during the period 1988-1993, showing signs of fishery interactions such as net entanglement, mutilation, gunshot wounds, etc. (Southeast U.S. Marine Mammal Stranding Network unpublished data). This represented 9.6% of the total bottlenose dolphin strandings reported for the entire U.S. Gulf of Mexico. Morgan and Patton (1990) reported that 12.9% of 116 cetacean carcasses examined by Mote Marine Laboratory's marine mammal stranding response program on the west coast of Florida between 1984 and 1990 exhibited evidence of human-caused mortality or serious injury.

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a nearby coastal stock; however, the proportion of the stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Some of these stocks were the focus of a live-capture fishery for bottlenose dolphins which supplied dolphins to the U.S. Navy and to oceanaria for research and for public display for almost two decades (NMFS unpublished data). During the period between 1972-89, 490 bottlenose dolphins, an average of 29 dolphins annually, were removed from a few locations in the Gulf of Mexico, including the Florida Keys. Mississippi Sound sustained the highest level of removals and 202 dolphins were removed from this stock during this period, representing 41% of the total and an annual average of 12 dolphins (compared to a current PBR of 13). The annual average number of removals never exceeded the current PBR levels, but it may be biologically significant that 73% of the dolphins removed during 1982-88 were females. The impact of those removals on the stocks is unknown.

Fishery-related mortality and serious injury for each of these stocks is not known, but considering the evidence from stranding data, the total fishery-related mortality and serious injury exceeds 10% of the total PBR and, therefore, is not 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

Annual fishing effort for the shrimp trawl fishery in the U.S. Gulf of Mexico bays, sounds, and estuaries during 1988-1993 averaged approximately 2.20 million hours of tows (CV = 0.11) (NMFS unpublished data). There have been no reports of incidental mortality or injury in any of these stocks associated with the shrimp trawl fishery.

A fishery for blue crabs operates in estuarine areas throughout the Gulf of Mexico coast employing traps attached to a buoy with rope. Bottlenose dolphins have been reported stranded with polypropylene rope around their flukes (NMFS 1991; NMFS unpublished data) indicating the possibility of entanglement with crab pot lines; however, entanglement has not been reported by fishermen. This fishery has not been monitored by observers and there are no estimates of bottlenose dolphin mortality or serious injury for this fishery.

Gillnets are not used in Texas, and gillnets over 46 m^3 in area will not be allowed in Florida past July 1995, but fixed and runaround gillnets are currently in use in Louisiana, Mississippi, and Alabama. These fisheries, for the most part, operate year around. They are state-controlled and licensed, and vary widely in intensity and target species. No marine mammal mortalities associated with gillnet fisheries have been reported in these states, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury.

Other Mortality

The nearshore habitat occupied by many of these stocks is adjacent to areas of high human population and in some bays, such as Mobile Bay in Alabama and Galveston Bay in Texas, is highly industrialized. The area surrounding Galveston Bay, for example, has a coastal population of over 3 million people. More than 50% of all chemical products manufactured in the U.S. are produced there and 17% of the oil produced in the Gulf of Mexico is refined there (Henningsen and Würsig 1991). Many of the enclosed bays in Texas are surrounded by agricultural lands which receive periodic pesticide applications.

Concentrations of chlorinated hydrocarbons and metals were examined in conjunction with an anomalous mortality event of bottlenose dolphins in Texas bays in 1990, and were relatively low in most; however, some had concentrations at levels of possible toxicological concern (Varanasi et al. 1992). No studies to date have determined the amount, if any, of indirect human-induced mortality resulting from pollution or habitat degradation. A recent assessment of the health of 35 bottlenose dolphins from Matagorda Bay, Texas, however, associated high levels of chlorinated hydrocarbons with low health assessment scores (Reif et al., in preparation).

STATUS OF STOCK

The status of these stocks relative to OSP is unknown and this species is not listed as threatened or endangered under the Endangered Species Act. The occurrence of three anomalous mortality events among bottlenose dolphins along the U.S. Gulf of Mexico coast since 1990 (NMFS unpublished data) is cause for concern; however, the effects of the mortality events on stock abundance have not yet been determined. The available evidence suggests that bottlenose dolphin stocks in the northern and western coastal portion of the U.S. Gulf of Mexico may have experienced morbillivirus epidemic in 1993 (Lipscomb 1993; Lipscomb et al. 1994). Seven of 35 live-captured bottlenose dolphins (20%) from Matagorda Bay, Texas, in 1992, tested positive for previous exposure to cetacean morbillivirus (Reif et al., in preparation) and it is possible that other estuarine resident stocks have been exposed to the morbillivirus.

Low-level monitoring surveys in Mississippi Sound indicated a significantly lower average summer bottlenose dolphin abundance between 1985 and 1993 (NMFS unpublished data). The apparent decline in summer abundance of bottlenose dolphins in Mississippi Sound is evidence of a possible downward trend in abundance; however, there are insufficient data available with which to conduct a trend analysis. The relatively high number of bottlenose dolphin deaths which occurred during the recent mortality events suggests that some of these stocks may be stressed. For these reasons, and because the PBR for most of these stocks would be exceeded with the incidental capture of a single dolphin, each of these stocks is a strategic stock.

REFERENCES

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.

Blaylock, R. A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Mem. NMFS-SEFSC-356, 10 pp.

Bräger, S. 1992. Untersuchungen zur Ortstreue und zum Vergesellschaftungmuster des Großen Tümmlers, *Tursiops truncatus* (Montagu, 1821). Diploma thesis, Christian-Albrechts-Universität, Kiel, Germany, 97 pp.

Bräger, S. 1993. Diurnal and seasonal behavior patterns of bottlenose dolphins (*Tursiops truncatus*). Mar. Mam. Sci. 9: 434-440.

Bräger, S., B. Würsig, Alejandro Acevedo, and T. Henningsen. 1994. Association patterns of bottlenose dolphins (*Tursiops truncatus*) in Galveston Bay, Texas. J. Mamm. 75(2): 431-437.

Buckland, S. T., D. R. Anderson, K. P. Burnham, and J. L. Laake. 1993. Distance sampling: Estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Duffield, D. A. and R. S. Wells. 1986. Population structure of bottlenose dolphins: Genetic studies of bottlenose dolphins along the central west coast of Florida. Contract Report to National marine Fisheries Service, Southeast Fisheries Center, Contract No. 45-WCNF-5-00366, 16 pp.

Gruber, J. A. 1981. Ecology of the Atlantic bottlenosed dolphin (*Tursiops truncatus*) in the Pass Cavallo area of Matagorda Bay, Texas. M. Sc. thesis. Texas A&M University, College Station, 182 pp.

Henningsen, T. 1991. Zur Verbreitung und Ökologie des Großen Tümmlers (*Tursiops truncatus*) in Galveston, Texas. Diploma thesis, Christian-Albrechts-Universität, Kiel, Germany, 80 pp.

Henningsen, T. and B. Würsig. 1991. Bottle-nosed dolphins in Galveston Bay, Texas: Numbers and activities. Pages 36-38, *in* P. G. H. Evans (editor), European research on cetaceans - 5. Proceedings of the Fifth Annual Conference of the European Cetacean Society, Sandefjord, Norway, 21-23 February, 1991. Cambridge, UK.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Lipscomb, T. P. 1993. Some answers to questions about morbillivirus. Pages 4-5 *in* R. A. Blaylock, B. Mase, and D. K. Odell (editors), Strandings, Vol. 2, No. 3, SEFSC Miami Laboratory, Miami, Florida, 7 pp.

Lipscomb, T. P. 1994. Morbilliviral disease in an Atlantic bottlenose dolphin (*Tursiops truncatus*) from the Gulf of Mexico. Journal of Wildlife Diseases 30(4): 572-576.

Lynn, S. K. 1995. Movements, site fidelity, and surfacing patterns of bottlenose dolphins on the central Texas coast. M. Sc. thesis, Texas A&M University, College Station, 92 pp.

McHugh, M. B. 1989. Population numbers and feeding behavior of the bottlenose dolphin (*Tursiops truncatus*) near Aransas Pass, Texas. M. A. thesis. University of Texas, Austin, 97 pp.

Morgan, M. A. and G. W. Patton. 1990. Human dolphin interactions on the west coast of Florida: Documentation from MML's marine mammal response program. MML Technical Report #191, 9 pp.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement, June 1991.

Reif, J. S., L. J. Hansen, S. Galloway, G. Mitchum, T. L. Schmitt. In preparation. The relationship between chlorinated hydrocarbon contaminants and selected health parameters in bottlenose dolphins (*Tursiops truncatus*) from Matagorda Bay, Texas, 1992. Colorado State University, Fort Collins, and NMFS, Southeast Fisheries Science Center, Miami, Florida.

Reilly, S. B. and J. Barlow. 1986. Rates of increase in dolphin population size. Fish. Bull., U.S. 84(3): 527-533.

Scott, G. P. 1990. Management-oriented research on bottlenose dolphins by the Southeast Fisheries Center. Pages 623-639 *in* S. Leatherwood and R. R. Reeves (editors), The bottlenose dolphin. Academic Press, San Diego, 653 pp.

Scott, M. D., R. S. Wells, and A. B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. Pages 235-244 *in* S. Leatherwood and R. R. Reeves (editors), The bottlenose dolphin. Academic Press, San Diego, 653 pp.

Shane, S. H. 1977. The population biology of the Atlantic bottlenose dolphin, *Tursiops truncatus*, in the Aransas Pass area of Texas. M. Sc. thesis. Texas A&M University, College Station, 238 pp.

Varanasi, U., K. L. Tilbury, D. W. Brown, M. M. Krahn, C. A. Wigren, R. C. Clark, and S-L. Chan. 1992. Pages 56-86 *in* L. J. Hansen (editor), Report on Investigation of 1990 Gulf of Mexico Bottlenose Dolphin Strandings, Southeast Fisheries Science Center Contribution MIA-92/93-21, 219 pp.

Wells, R. S. 1986a. Population structure of bottlenose dolphins: behavioral studies along the central west coast of Florida. Contract report to NMFS, SEFSC. Contract No. 45-WCNF-5-00366, 58 pp.

Wells, R. S. 1986b. Structural aspects of dolphin societies. Ph. D. dissertation. University of California at Santa Cruz, Santa Cruz, 234 pp.

Wells, R. S. 1992. The marine mammals of Sarasota Bay. Pages 9.1-9.23, *in* Sarasota Bay: Framework for action, Sarasota Bay National Estuary Program, Sarasota, Florida.

ATLANTIC SPOTTED DOLPHIN (*Stenella frontalis*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Atlantic spotted dolphin is endemic to the Atlantic Ocean in warm temperate to tropical waters (Perrin et al. 1987, 1994). Sightings of this species are concentrated along the continental shelf edge and also occur over the continental shelf in the northern Gulf of Mexico [Fritts et al. 1983; Mullin et al. 1991; Southeast Fisheries Science Center (SEFSC) unpublished data], but they have been reported as occurring around oceanic islands and far offshore in other areas (Perrin et al. 1994). The island and offshore animals may be a different stock than those occurring on the continental shelf (Perrin et al. 1994). Atlantic spotted dolphins were seen in all seasons during seasonal recent GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). Atlantic spotted dolphins were seen in 1992 during regional aerial surveys conducted in the autumn of 1992-1994 over the U.S. continental shelf [see Blaylock and Hoggard (1994) for a description of the areas surveyed in 1992-1993]. These surveys were designed to estimate abundance of bottlenose dolphins and spotted dolphin abundance was not estimated. It has been suggested that there may be a seasonal movement of this species onto the continental shelf in the spring, but data supporting this hypothesis are limited (Caldwell and Caldwell 1966; Fritts et al. 1983).

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of Atlantic spotted dolphins [coefficient of variation (CV) in parentheses] by survey year was zero in 1991, 4,527 in 1992 (0.65), 4,618 in 1993 (0.62), and 2,186 in 1994 (0.85) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of Atlantic spotted dolphins for all surveys combined was 3,213 (CV = 0.44) (Hansen et al. 1995). This is probably an underestimate and should be considered a partial stock estimate because the continental shelf areas were not generally covered by either the vessel or GulfCet aerial surveys.

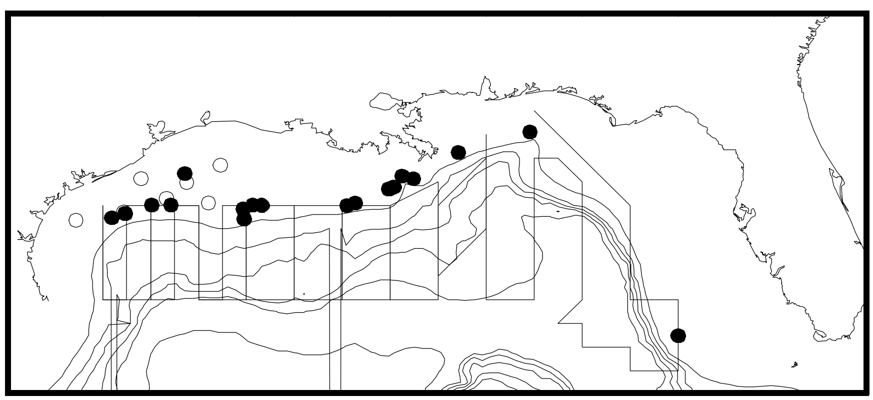


Figure 1. *Distribution of Atlantic spotted dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994 (filled circles) and during GOMEX regional aerial surveys during 1992-1994 (unfilled circles). The straight lines show transects during two ship surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated using the average abundance estimate of Atlantic spotted dolphins for all surveys combined which was 3,213 (CV = 0.44) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 2,255 Atlantic spotted dolphins.

Current Population Trend

No trend was identified in the annual abundance estimates. There were no sightings of this stock during 1991. The lack of sightings during 1991 may have been due to less sampling that year along the continental shelf edge where sightings of this species were concentrated. The difference in abundance estimates during 1992-1994 were not significant using the criteria of no overlap of log-normal 95 % confidence intervals.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. The resulting PBR, based on the partial estimate, for this stock is 23 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of Atlantic spotted dolphins in the northern Gulf of Mexico is unknown; however, interactions between spotted dolphins and fisheries have been observed in the northern Gulf of Mexico.

There were two documented strandings of Atlantic spotted dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Total estimated average annual fishing-related mortality and serious injury of spotted dolphins (both species) is 1.5 spotted dolphins annually (CV = 0.33). Observed fishery-related mortality and serious injury for spotted dolphins is less than 10% of PBR and can be considered insignificant and approaching zero mortality and serious injury rate for this stock. 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were two observed incidental takes and releases of spotted dolphins in the Gulf of Mexico during 1994, but no observed lethal takes of Atlantic spotted dolphins by this fishery in the Gulf of Mexico.

Estimates of fishery-related mortality and serious injury were based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take for the entire Atlantic longline swordfish/tuna fishery (which includes the Gulf of Mexico) (SEFSC, unpublished data). Takes observed throughout the range of this fishery were used because the species occurs generally throughout the area of the fishery, but observed takes were infrequent in any given region. Either spotted dolphin species may have been involved in the observed fishery-related mortality and serious injury incidents, but because of the difficulty of species identification by fishery observers, they cannot currently be separated. Estimated mortality and serious injury to spotted dolphins attributable to the longline fishery for the entire fishery (including waters outside of the Gulf of Mexico) for 1993 was 16 (CV = 0.19). Estimated fishery-related mortality and serious injury for the Gulf of Mexico, based on proportionality of fishing effort (number of sets) in 1993 was 4.4 spotted dolphins. Estimated average annual fishing-related mortality and serious injury of spotted dolphins attributable to this fishery during 1991-1993 was 1.5 annually (CV = 0.33).

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be low relative to PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Blaylock, R. A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. NOAA Tech. Mem. NMFS-SEFSC-356, 10 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Caldwell, D. K. and M. C. Caldwell. 1966. Observations on the distribution, coloration, behavior and audible sound production of the spotted dolphin, *Stenella plagiodon* (Cope). Los Angeles County Museum Contribution to Science, 104:1-28.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Fritts, T. H., A. B. Irvine, R. D. Jennings, L. A. Collum, W. Hoffman and M. A. McGehee. 1983. Turtles, birds, and mammals in the northern Gulf of Mexico and nearby Atlantic waters. U.S. Fish and Wildlife Service, Division of Biological Services, Washington, D. C., FWS/OBS-82/65, 455 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, 108 pp.

Perrin, W. F., E. D. Mitchell, J. G. Mead, D. K. Caldwell, M. C. Caldwell, P. J. H. van Bree and W. H. Dawbin. 1987. Revision of the spotted dolphins, *Stenella* spp. Mar. Mam. Sci. 3(2):99-170.

Perrin, W. F., D. K. Caldwell and M. C. Caldwell. 1994. Atlantic spotted dolphin *Stenella frontalis* (G. Cuvier, 1829). Pages 173-190 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

PANTROPICAL SPOTTED DOLPHIN (*Stenella attenuata*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pantropical spotted dolphin is distributed worldwide in tropical and some sub-tropical oceans (Perrin et al. 1987; Perrin and Hohn 1994). Sightings of this species occurred over the deeper waters of the northern Gulf of Mexico, and rarely over the continental shelf or continental shelf edge [Mullin et al. 1991; Southeast Fisheries Science Center (SEFSC) unpublished data]. Pantropical spotted dolphins were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). Some of the Pacific populations have been divided into different geographic stocks based on morphological characteristics (Perrin et al. 1987; Perrin and Hohn 1994); however, there is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of pantropical spotted dolphins by survey year [coefficient of variation (CV) in parentheses] was 19,767 in 1991 (0.45), 15,280 in 1992 (0.36), 29,414 in 1993 (0.29), and 71,847 in 1994 (0.31) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of pantropical spotted dolphins for all surveys combined was 31,320 (CV = 0.20) (Hansen et al. 1995).

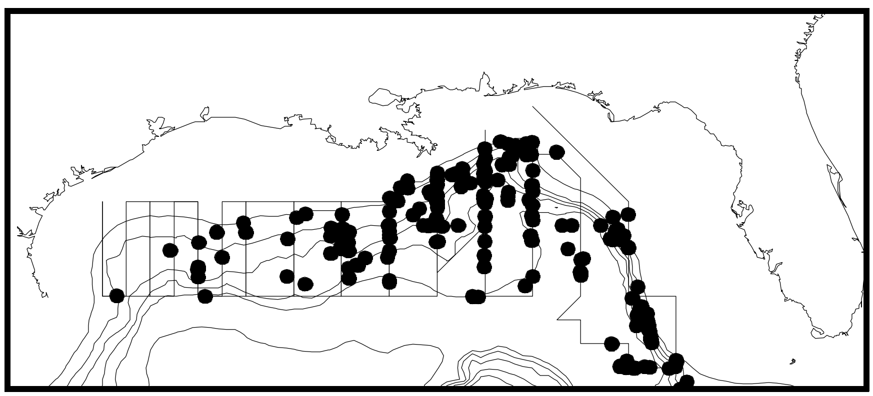


Figure 1. *Distribution of pantropical spotted dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance of pantropical spotted dolphins which was 31,320 (CV = 0.20) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 26,510 pantropical spotted dolphins.

Current Population Trend

The 1994 abundance estimate was larger than the estimates for 1991-1993. The 1992 and 1994 estimates were significantly different using the criteria of no overlap of log-normal 95% confidence intervals, but differences within 1991-1993 estimates and differences between 1991, 1993, and 1994 were not significant. The observed differences in abundance estimates may have been caused by inter-annual variation in distribution patterns and spatial sampling, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. The resulting PBR for this stock is 265 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of pantropical spotted dolphins in the northern Gulf of Mexico is unknown; however, interactions between spotted dolphins and fisheries have been observed in the northern Gulf of Mexico.

There was one documented stranding of a pantropical spotted dolphin in the northern Gulf of Mexico during 1987-1994 which was classified as likely caused by fishery interactions. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Total estimated average annual fishing-related mortality and serious injury of spotted dolphins (both species) is 1.5 spotted dolphins annually (CV = 0.33). Observed fishery-related mortality and serious injury for spotted dolphins is less than 10% of PBR and can be considered insignificant and approaching zero mortality and serious injury rate for this stock. 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were two observed incidental takes and releases of spotted dolphins in the Gulf of Mexico during 1994, but no observed lethal takes of Atlantic spotted dolphins by this fishery in the Gulf of Mexico.

Estimates of fishery-related mortality and serious injury were based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take for the entire Atlantic longline swordfish/tuna fishery (which includes the Gulf of Mexico) (SEFSC, unpublished data). Takes observed throughout the range of this fishery were used because the species occurs generally throughout the area of the fishery, but observed takes were infrequent in any given region. Either spotted dolphin species may have been involved in the observed fishery-related mortality and serious injury incidents, but because of the difficulty of species identification by fishery observers, they cannot currently be separated. Estimated mortality and serious injury to spotted dolphins attributable to the longline fishery for the entire fishery (including waters outside of the Gulf of Mexico) for 1993 was 16 (CV = 0.19). Estimated fishery-related mortality and serious injury for the Gulf of Mexico, based on proportionality of fishing effort (number of sets) in 1993 was 4.4 spotted dolphins. Estimated average annual fishing-related mortality and serious injury of spotted dolphins attributable to this fishery during 1991-1993 was 1.5 annually (CV = 0.33).

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, 108 pp.

Perrin, W. F., E. D. Mitchell, J. G. Mead, D. K. Caldwell, M. C. Caldwell, P. J. H. van Bree, and W. H. Dawbin. 1987. Revision of the spotted dolphins, *Stenella* spp. Mar. Mam. Sci. 3(2): 99-170.

Perrin, W. F. and A. A. Hohn. 1994. Pantropical spotted dolphin *Stenella attenuata*. Pages 71-98 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

STRIPED DOLPHIN (*Stenella coeruleoalba*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The striped dolphin is distributed worldwide in tropical to warm temperate oceanic waters (Leatherwood and Reeves 1983; Perrin et al. 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Mullin et al. 1991; Southeast Fisheries Science Center (SEFSC) unpublished data]. Striped dolphins were seen in fall, winter, and spring during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of striped dolphins by survey year [coefficient of variation (CV) in parentheses] was 3,483 in 1991 (0.76), 2,574 in 1992 (0.52), 4,160 in 1993 (0.63), and 8,147 in 1994 (0.60) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of striped dolphins for all surveys combined was 4,858 (CV = 0.44) (Hansen et al. 1995).

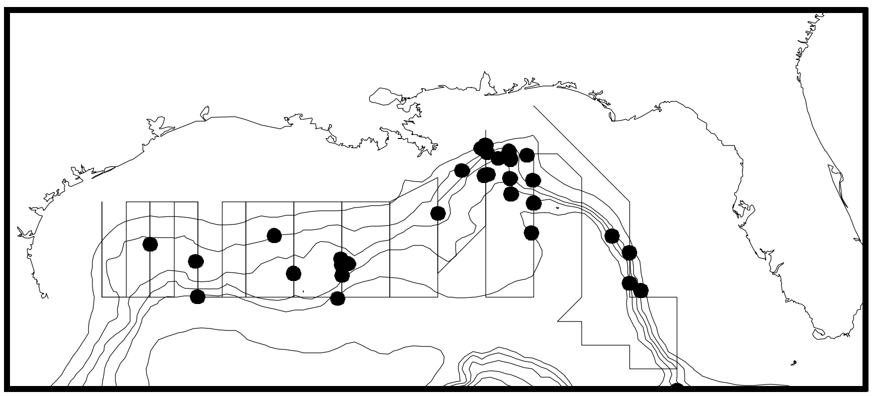


Figure 1. *Distribution of striped dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimate abundance which was 4,858 striped dolphins (CV = 0.44) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 3,409 striped dolphins.

Current Population Trend

The abundance estimates for 1991-1993 were less than the 1994 estimate. The abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by small sample sizes; only 29 observations of herds of striped dolphins were used in the distance sampling analysis. The differences in the estimates may also have been caused by inter-annual variation in distribution patterns and spatial sampling, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. PBR for this stock is 34 striped dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of striped dolphins in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with striped dolphins in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of striped dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to striped dolphins by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, 108 pp.

Perrin, W. F., C. E. Wilson and F. I. Archer II. 1994. Striped dolphin *Stenella coeruleoalba* (Meyen, 1833). Pages 129-159 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

SPINNER DOLPHIN (*Stenella longirostris*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The spinner dolphin is distributed worldwide in tropical to warm temperate waters in the world's oceans (Leatherwood and Reeves 1983; Perrin and Gilpatrick 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Southeast Fisheries Science Center (SEFSC) unpublished data]. Spinner dolphins were seen in winter, spring and summer during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). Different geographic stocks have been identified in the Pacific based on morphological characteristics (Perrin and Gilpatrick 1994); however, there is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of spinner dolphins by survey year [coefficient of variation (CV) in parentheses] was zero in 1991, 2,593 in 1992 (0.63), 2,336 in 1993 (0.62), and 15,995 in 1994 (0.67) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of spinner dolphins for all surveys combined was 6,316 (CV = 0.43) (Hansen et al. 1995).

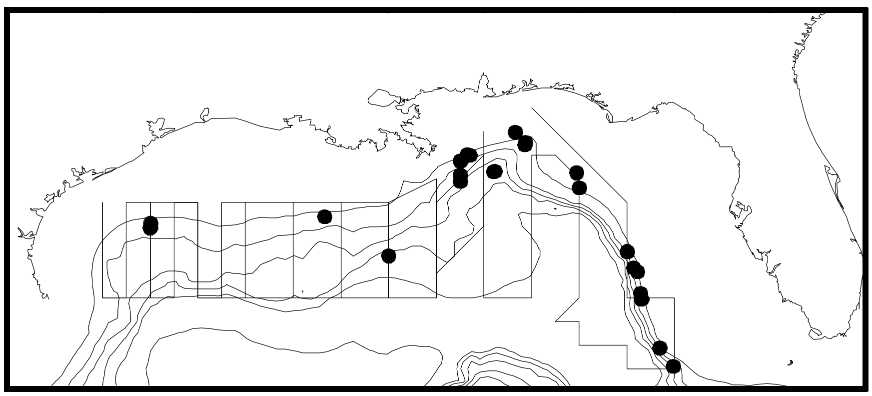


Figure 1. *Distribution of spinner dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimate abundance which was 6,316 spinner dolphins (CV = 0.43) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 4,465 spinner dolphins.

Current Population Trend

The abundance estimates for 1992 and 1993 were approximately the same and the 1994 estimate was considerably larger; however, the estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by less sampling effort during 1991 (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates for this stock are not known; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. PBR for this stock is 45 spinner dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of spinner dolphins in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with spinner dolphins in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of spinner dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of spinner dolphins by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report, OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Perrin, W. F. and J. W. Gilpatrick, Jr. 1994. Spinner dolphin *Stenella longirostris* (Gray, 1828). Pages 99-128 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

ROUGH-TOOTHED DOLPHIN (*Steno bredanensis*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The rough-toothed dolphin is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983; Miyazaki and Perrin 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Southeast Fisheries Science Center (SEFSC) unpublished data]. Rough-toothed dolphins were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of rough-toothed dolphins by survey year [coefficient of variation (CV) in parentheses] was 545 in 1991 (1.15), 758 in 1992 (0.58), 1,192 in 1993 (0.48), and 527 in 1994 (0.86) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of rough-toothed dolphins for all surveys combined was 852 (CV = 0.31) (Hansen et al. 1995).

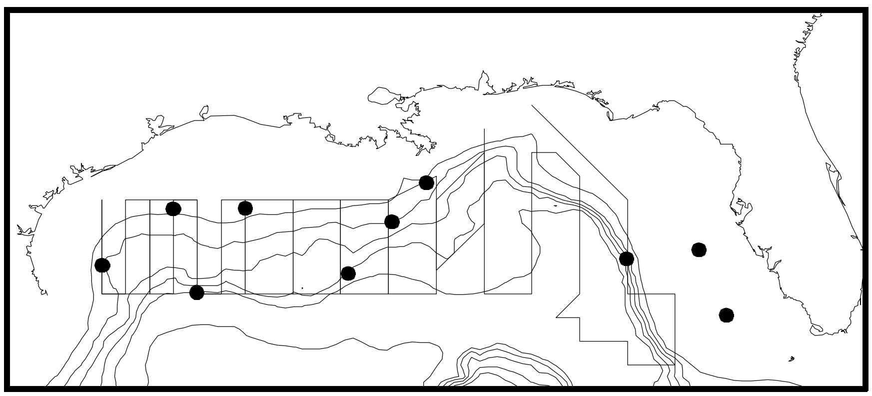


Figure 1. *Distribution of rough-toothed dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimate abundance which was 852 rough-toothed dolphins (CV = 0.31) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 660 rough-toothed dolphins.

Current Population Trend

The 1993 abundance estimate was greater than the 1991, 1993, and 1994 estimates; however, the abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by small sample sizes (Hansen et al. 1995) or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. The resulting PBR for this stock is 6.6 rough-toothed dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of rough-toothed dolphins in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with rough-toothed dolphins in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of rough-toothed dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of rough-toothed dolphins by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Miyazaki, N. and W. F. Perrin. 1994. Rough-toothed dolphin *Steno bredanensis* (Lesson, 1828). Pages 1-21 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

CLYMENE DOLPHIN (*Stenella clymene*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Clymene dolphin is endemic to tropical and sub-tropical waters of the Atlantic (Leatherwood and Reeves 1983; Perrin and Mead 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf (Mullin et al. 1994). Clymene dolphins were seen in the winter, spring and summer during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of Clymene dolphins by survey year [coefficient of variation (CV) in parentheses] was 1,936 in 1991 (0.69), 3,390 in 1992 (0.48), 6,486 in 1993 (0.46), and 12,255 in 1994 (0.62) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of Clymene dolphins for all surveys combined was 5,571 (CV = 0.37) (Hansen et al. 1995).

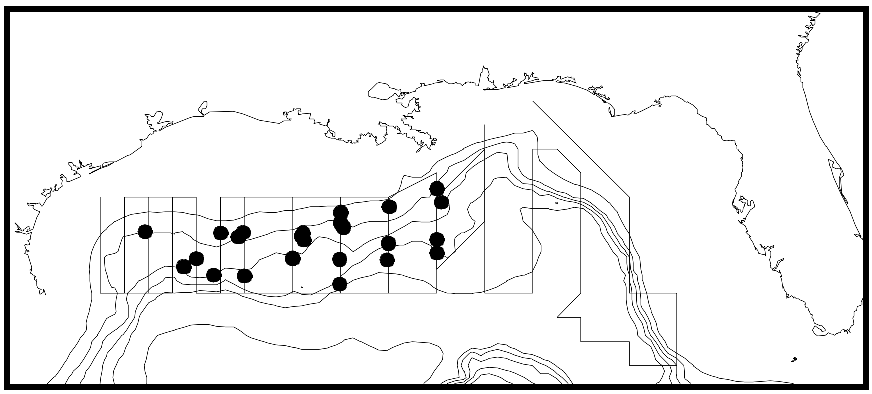


Figure 1. *Distribution of clymene dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimate abundance which was 5,571 Clymene dolphins (CV = 0.37) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 4,120 Clymene dolphins.

Current Population Trend

The abundance estimates showed an increasing trend during 1991-1994; however, the estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by small sample sizes (Hansen et al. 1995) or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. PBR for this stock is 41 Clymene dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of Clymene dolphins in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with Clymene dolphins in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of Clymene dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to Clymene dolphins by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Mullin, K. D., L V. Higgins, T. A. Jefferson, and L. J. Hansen. 1994. Sightings of the Clymene dolphin (*Stenella clymene*) in the Gulf of Mexico. Mar. Mam. Sci. 10(4): 464-470.

Perrin, W. F. and J. G. Mead. 1994. Clymene dolphin *Stenella clymene* (Gray, 1846). Pages 161-171 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

FRASER'S DOLPHIN (*Lagenodelphis hosei*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fraser's dolphin is distributed worldwide in tropical waters (Perrin et al. 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf (Leatherwood et al. 1993). Fraser's dolphins have been observed recently in the northern Gulf of Mexico during the spring, summer, and fall (Leatherwood et al. 1993), and also were seen in the winter during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of Fraser's dolphins by survey year [coefficient of variation (CV) in parentheses] was zero in 1991, 443 in 1992 (0.92), and zero in 1993 and 1994 (Hansen et al. 1995). Survey effort-weighted estimated average abundance of Fraser's dolphins for all vessel surveys combined was 127 (CV = 0.90) (Hansen et al. 1995).

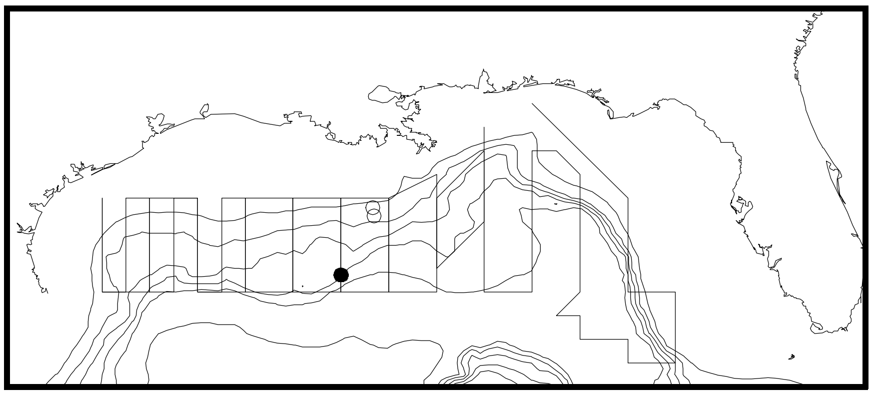


Figure 1. *Distribution of Fraser's dolphin sightings during NOAA Ship Oregon II surveys during 1991-1994 (filled circle) and during GulfCet seasonal aerial surveys (unfilled circles). The straight lines show transects during two ship surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimate abundance which was 127 Fraser's dolphins (CV = 0.90) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 66 Fraser's dolphins.

Current Population Trend

No trend was identified in the annual abundance estimates. There were no observations of Fraser's dolphins during 1991 and 1993 vessel surveys, and the 1992 estimate is based on only one observation (Hansen et al. 1995); however, five other sightings of Fraser's dolphins were documented in the northern Gulf of Mexico during other surveys in 1992, 1993 and 1994 (Leatherwood et al. 1993, SEFSC unpublished data). The apparent differences in abundance estimates may have been caused by low sampling intensity relative to population size (Hansen et al. 1995) or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. PBR for this stock is 0.7 Fraser's dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of Fraser's dolphins in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with Fraser's dolphins in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of Fraser's dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Available information indicates there likely is little, if any, fisheries interaction with Fraser's dolphins in the northern Gulf of Mexico. The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of Fraser's dolphins by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S., T. A. Jefferson, J. C. Norris, W. E. Stevens, L. J. Hansen, and K. D. Mullin. 1993. Occurrence and sounds of Fraser's dolphin in the Gulf of Mexico. The Texas Journal of Science, 45(4):349-354.

Perrin, W. F., S. Leatherwood and A. Collet. 1994. Fraser's dolphin *Lagenodelphis hosei* (Fraser 1956). Pages 225-240 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

KILLER WHALE (*Orcinus orca*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The killer whale is distributed worldwide from tropical to polar regions (Leatherwood and Reeves 1983). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Southeast Fisheries Science Center (SEFSC) unpublished data]. Killer whales were seen only in the summer during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation) and in the late spring during vessel surveys (SEFSC unpublished data). Different stocks have been identified in the northeastern Pacific based on morphological, behavioral, and genetic characteristics (Bigg et al. 1990; Hoelzel 1991). There is no information on stock differentiation for the Atlantic population, although an analysis of vocalizations of killer whales from Iceland and Norway indicated that stocks from these areas may represent different stocks (Moore et al. 1988).

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated killer whale abundance by survey year [coefficient of variation (CV) in parentheses] was zero in 1991, 138 in 1992 (0.96), 641 in 1993 (0.50), and 193 in 1994 (1.12) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of killer whales for all surveys combined was 277 (CV = 0.42) (Hansen et al. 1995).

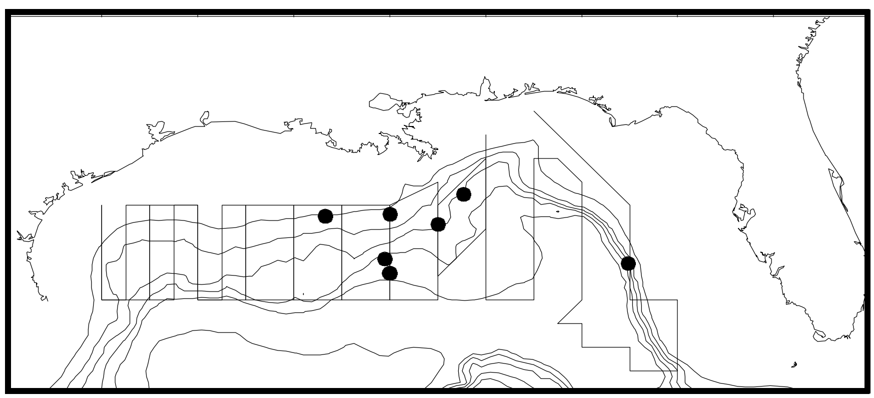


Figure 1. *Distribution of killer whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimate abundance which was 277 killer whales (CV = 0.42) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 197 killer whales.

Current Population Trend

The abundance estimates were highest during 1993; however, there were no observations of this species during 1991, and the 1992-1994 estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, and by low sampling intensity relative to population size (Hansen et al. 1995) or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size. Preliminary analysis of existing photo-identification data shows that some individual whales have been seen during more than one survey (SEFSC unpublished data).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates for this stock are not known; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. PBR for this stock is 2.0 killer whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of killer whales in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with killer whales in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of killer whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of killer whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Bigg, M. A., P. F. Olesiuk, G. M. Ellis, J. K. B. Ford and K. C. Balcomb. 1990. Social organization and genealogy of resident killer whales (*Orcinus orca*) in the coastal waters of British Columbia and Washington State. Pages 383-405 *in* P. S. Hammond, S. A. Mizroch and G. P. Donovan (editors), Individual recognition of cetaceans: Use of photoidentification and other techniques to estimate population parameters, Rep. Int. Whal. Commn., Special Issue 12, Cambridge, 440 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Hoelzel, A. R. 1991. Analysis of regional mitochondrial DNA variation in the killer whale; implications for conservation. Pages 225-233 *in* A. R. Hoelzel (editor), Genetic ecology of whales and dolphins, Rep. Int. Whal. Commn. Special Issue 13, Cambridge, 311 pp.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Moore, S. E., J. K. Francine, A. E. Bowles and K. B. Ford. 1988. Analysis of calls of killer whales, *Orcinus orca*, from Iceland and Norway. Rit. Fiskideild. 11:225-250.

FALSE KILLER WHALE (*Pseudorca crassidens*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The false killer whale is distributed worldwide throughout warm temperate and tropical oceans (Leatherwood and Reeves 1983). Sightings of this species in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Southeast Fisheries Science Center (SEFSC) unpublished data]. False killer whales were seen only in the summer during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation) and in the late spring during vessel surveys (NMFS unpublished data). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of false killer whales by survey year [coefficient of variation (CV) in parentheses] was 661 in 1991 (0.88), 196 in 1992 (1.00), 77 in 1993 (1.08), and 744 in 1994 (1.14) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of false killer whales for all surveys combined was 381 (CV = 0.62) (Hansen et al. 1995).

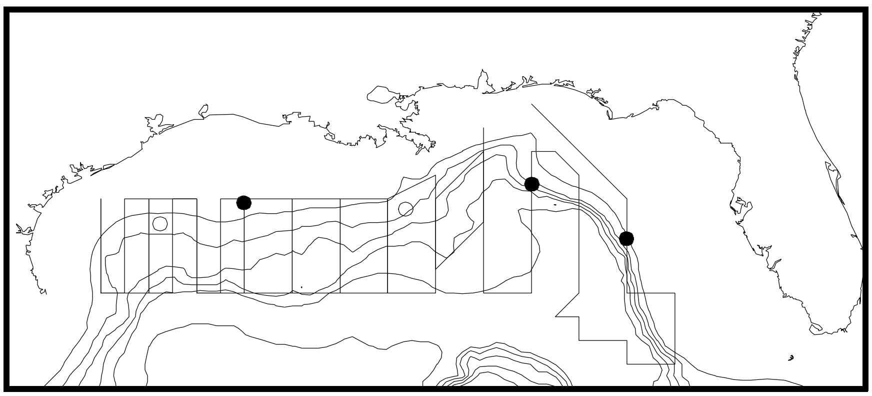


Figure 1. *Distribution of false killer whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994 (filled circles) and during GulfCet seasonal aerial surveys (filled circles). The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimate abundance which was 381 false killer whales (CV = 0.62) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 236 false killer whales.

Current Population Trend

No trend was identified in the annual abundance estimates, and the differences in the abundance estimates were not significant using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. PBR for this stock is 2.4 false killer whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of false killer whales in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with false killer whales in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of false killer whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of false killer whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

PYGMY KILLER WHALE (*Feresa attenuata*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy killer whale is distributed worldwide in tropical and subtropical waters (Ross and Leatherwood 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Southeast Fisheries Science Center (SEFSC) unpublished data]. Pygmy killer whales and melon-headed whales (*Peponocephala electra*) are difficult to distinguish and sightings of either species are often categorized as pygmy killer/melon-headed whales. Sightings of this category were documented in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of pygmy killer whales by survey year [coefficient of variation (CV) in parentheses] was 2,347 in (0.81), 356 in 1992 (0.73), 153 in 1993 (1.13), and zero in 1994 (Hansen et al. 1995). Survey effort-weighted estimated average abundance of pygmy killer whales for all surveys combined was 518 (CV = 0.81) (Hansen et al. 1995).

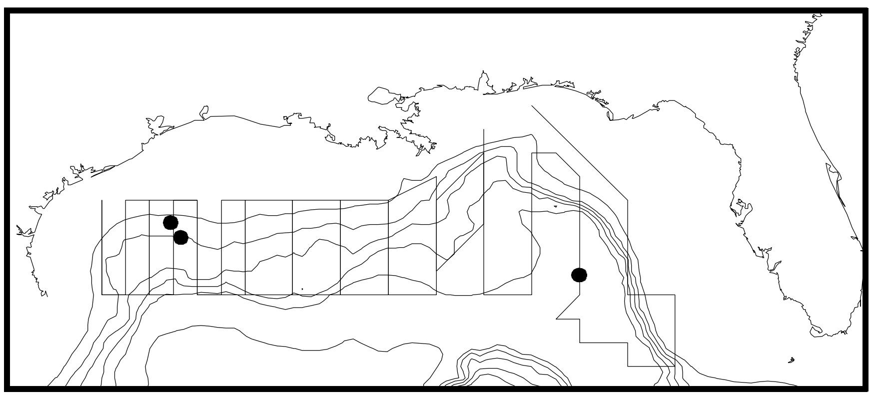


Figure 1. *Distribution of pygmy killer whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 518 pygmy killer whales (CV = 0.81) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 285 pygmy killer whales.

Current Population Trend

A declining trend was identified in the annual abundance estimates; however, the 1991-1993 abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. There were no observations of this species during the 1994 survey. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. PBR for this stock is 2.8 pygmy killer whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell and Caldwell 1971); however, the level of past or current, direct, human-caused mortality of pygmy killer whales in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with pygmy killer whales in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of pygmy killer whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of pygmy killer whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Caldwell, D. K. and M. C. Caldwell. 1971. The pygmy killer whale, *Feresa attenuata*, in the western Atlantic, with a summary of world records. J. Mamm. 52:206-209.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Ross, G. J. B. and S. Leatherwood. 1994. Pygmy killer whale *Feresa attenuata* (Gray, 1874). Pages 387-404 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

DWARF SPERM WHALE (*Kogia simus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The dwarf sperm whale appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily along the continental shelf edge and over the deeper waters off the continental shelf (Mullin et al. 1991; Southeast Fisheries Science Center, SEFSC, unpublished data). Dwarf sperm whales and pygmy sperm whales (*Kogia breviceps*) are difficult to distinguish and sightings of either species are often categorized as *Kogia* spp. Sightings of this category were documented in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). There is no information on stock differentiation.

POPULATION SIZE

Estimates of abundance of *Kogia* spp. were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of *Kogia* spp. by survey year [coefficient of variation (CV) in parentheses] was 109 in 1991 (0.68), 1,010 in 1992 (0.40), 580 in 1993 (0.45), and 162 in 1994 (0.61) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of *Kogia* spp. for all surveys combined was 547 (CV = 0.28) (Hansen et al. 1995). Estimates of dwarf sperm whale abundance cannot be provided due to uncertainty of species identification at sea.

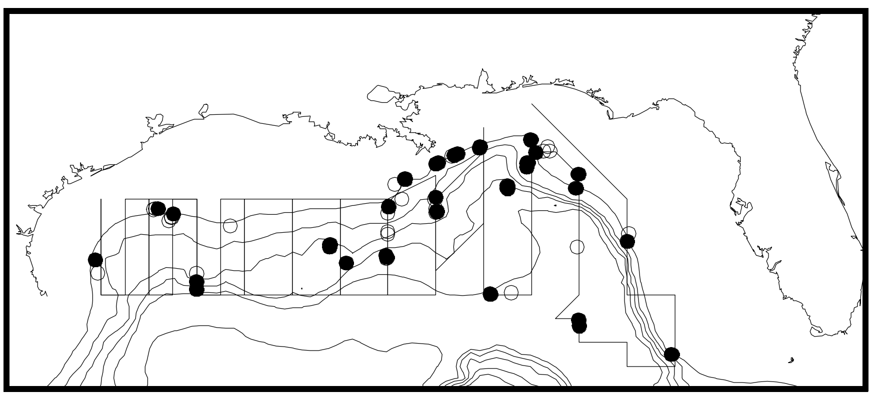


Figure 1. *Distribution of all Kogia sightings (unfilled circles) and sightings identified as dwarf sperm whales (filled circles) during NOAA Ship Oregon II marine mammal surveys in 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

A minimum population estimate was not calculated because of uncertainty of species identification at sea.

Current Population Trend

A declining trend is evident in the annual abundance estimates since 1992; however, the 1991, 1993 and 1994 abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, and by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was not calculated because the minimum population size cannot be calculated.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of dwarf sperm whales in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with dwarf sperm whales in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of dwarf sperm whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions, but there have been stranding investigation reports of dwarf sperm whales which may have died as a result of other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Although the PBR cannot be calculated, there is no known fishery-related mortality or serious injury to this stock and, therefore, total fishery-related mortality and serious injury can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of dwarf sperm whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

Other Mortality

A total of at least nine dwarf sperm whale strandings were documented in the northern Gulf of Mexico from 1987-present; one of these animals had a plastic bag in its stomach.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of fishery-related mortality and serious injury is unknown, but it is believed to be insignificant. Upon the advice of the Atlantic Scientific Review Group this stock has been designated a strategic stock because PBR cannot be determined and there is an unknown amount of possible human-caused mortality from the ingestion of marine debris such as plastic bags.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Caldwell, D. K. and M. C. Caldwell 1989. Pygmy sperm whale *Kogia breviceps* (de Blainville, 1838): dwarf sperm whale *Kogia simus* Owen, 1866. Pages 235-260 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, San Diego.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana 108 pp.

PYGMY SPERM WHALE (*Kogia breviceps*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy sperm whale appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily along the continental shelf edge and over the deeper waters off the continental shelf (Mullin et al. 1991; Southeast Fisheries Science Center, SEFSC, unpublished data). Pygmy sperm whales and dwarf sperm whales (*Kogia simus*) are difficult to distinguish and sightings of either species are often categorized as *Kogia* spp. Sightings of this category were documented in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). There is no information on stock differentiation.

POPULATION SIZE

Estimates of abundance of *Kogia* spp. were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of *Kogia* spp. by survey year [coefficient of variation (CV) in parentheses] was 109 in 1991 (0.68), 1,010 in 1992 (0.40), 580 in 1993 (0.45), and 162 in 1994 (0.61) (Hansen et al. 1995). Survey effort-weighted estimated abundance of *Kogia* spp. for all surveys combined was 547 (CV = 0.28) (Hansen et al. 1995). Estimates of pygmy sperm whale abundance cannot be provided due to uncertainty of species identification at sea.

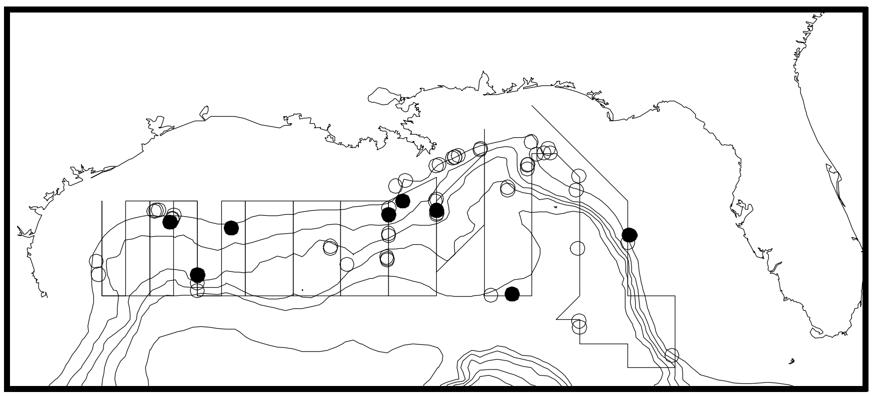


Figure 1. *Distribution of all Kogia sightings (unfilled circles) and sightings identified as pygmy sperm whales (filled circles) during NOAA Ship Oregon II marine mammal surveys in 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

A minimum population estimate could not be calculated because of uncertainty of species identification at sea.

Current Population Trend

A declining trend is evident in the annual abundance estimates since 1992; however, the 1991, 1993 and 1994 abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, and by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was not calculated because the minimum population size cannot be calculated.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of pygmy sperm whales in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with pygmy sperm whales in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There have been no documented strandings of pygmy sperm whales in the northern Gulf of Mexico during 1987-1994 which have been classified as likely caused by fishery interactions, but there have been stranding investigation reports of pygmy sperm whales which may have died as a result of other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Although the PBR cannot be calculated, the total known fishery-related mortality and serious injury for this stock is zero and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of pygmy sperm whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

Other Mortality

At least 13 pygmy sperm whale strandings were documented in the northern Gulf of Mexico from 1987-present; one of these animals had a plastic bag in its stomach and another stranded apparently due to injuries inflicted by impact, possibly with a vessel.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of fishery-related mortality and serious injury is unknown, but it is believed to be insignificant. Upon the advice of the Atlantic Scientific Review Group this stock has been designated a strategic stock because PBR cannot be determined and there is an unknown amount of possible human-caused mortality from the ingestion of marine debris such as plastic bags and possibly from collision with vessels.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Caldwell, D. K. and M. C. Caldwell 1989. Pygmy sperm whale *Kogia breviceps* (de Blainville, 1838): dwarf sperm whale *Kogia simus* Owen, 1866. Pages 235-260 *in* S. H. Ridgway and R. Harrison (editors), Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, San Diego.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana 108 pp.

MELON-HEADED WHALE (*Peponocephala electra*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The melon-headed whale appears to be distributed worldwide in tropical to sub-tropical waters (Perryman et al. 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf (Mullin et al. 1994). Melon-headed whales and pygmy killer whales (*Feresa attenuata*) are difficult to distinguish and sightings of either species are often categorized as pygmy killer/melon-headed whales. Sightings of this category were documented in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Seasonal aerial survey data were insufficient for estimating abundance. Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig.1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of melon-headed whales by survey year [coefficient of variation (CV) in parentheses] was zero in 1991, 3,174 in 1992 (0.54), 827 in 1993 (0.70) and 10,586 in 1994 (0.48) (Hansen et al. 1995). The survey effort-weighted estimated average abundance of melon-headed whales for all surveys combined was 3,965 (CV = 0.39) (Hansen et al. 1995).

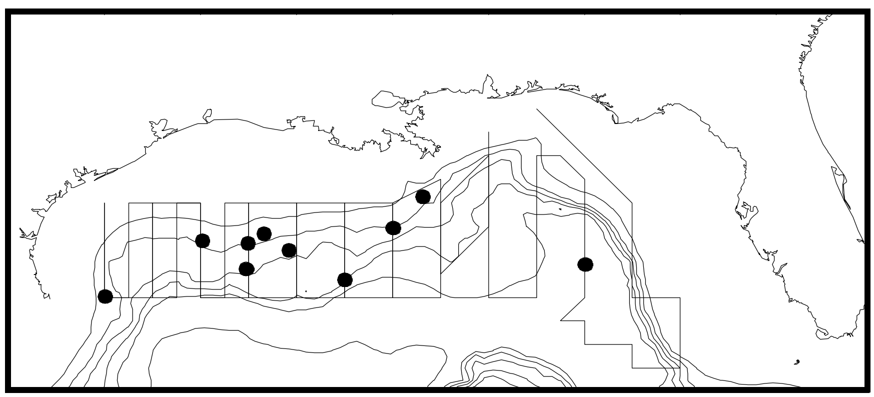


Figure 1. *Distribution of melon-headed whale sightings during NOAA Ship Oregon II marine mammal surveys in 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) depth intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average abundance estimate which was 3,965 (CV = 0.39) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 2,888 melon-headed whales.

Current Population Trend

No trend was identified in the annual abundance estimates; however, the 1994 estimate was more than ten times larger than the 1993 estimate and the difference was significant using the criteria of no overlap of log-normal 95% confidence intervals. No melon-headed whales were sighted during 1991, and the differences between the 1992 and 1993 estimates and between the 1993 and 1994 estimates were not significant. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, and by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. PBR for this stock is 29 melon-headed whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell et al. 1976); however, the level of past or current, direct, human-caused mortality of melon-headed whales in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with melon-headed whales in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of melon-headed whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to melon-headed whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown. This species is not listed under the Endangered Species Act. There are insufficient data to determine population trends. The total level of fishery-related mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Caldwell, D. K., M. C. Caldwell and R. V. Walker. 1976. First records for Fraser's dolphin (*Lagenodelphis hosei*) in the Atlantic and the melon-headed whale (*Peponocephala electra*) in the western Atlantic. Cetology 25: 1-4.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Mullin, K. D., T. A. Jefferson, L. J. Hansen and W. Hoggard. 1994. First sightings of melon-headed whales (*Peponocephala electra*) in the Gulf of Mexico. Mar. Mam. Sci. 10(3): 342-348.

RISSO'S DOLPHIN (*Grampus griseus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphin is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983). Sightings of these animals in the northern Gulf of Mexico occur primarily along the continental shelf and continental slope (Mullin et al. 1991; Southeast Fisheries Science Center, SEFSC, unpublished data). Risso's dolphin were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation) and in the late spring during vessel surveys (SEFSC, unpublished data). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Seasonal aerial survey data were insufficient for abundance estimation. Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig.1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of Risso's dolphins by survey year [coefficient of variation (CV) in parentheses] was 667 in 1991 (0.95), 2,325 in 1992 (0.34), 1,408 in 1993 (0.41), and 6,332 in 1994 (0.45) (Hansen et al. 1995). Survey effort-weighted average abundance of Risso's dolphins estimated for all surveys combined was 2,749 (CV = 0.27) (Hansen et al. 1995).

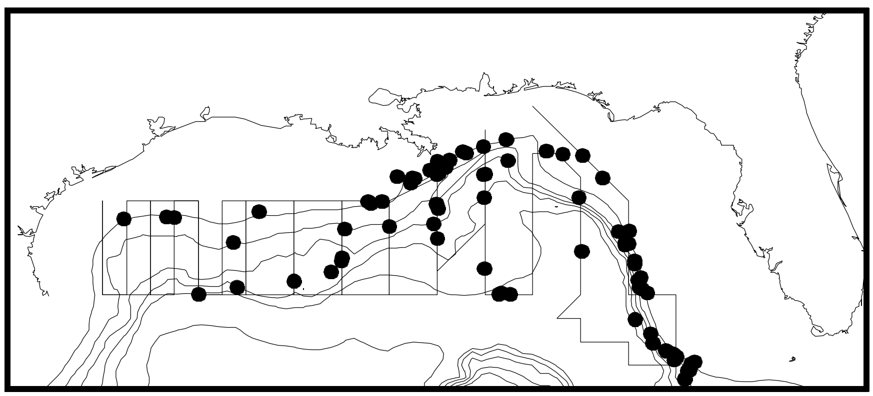


Figure 1. *Distribution of Risso's dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average abundance estimate which was 2,749 Risso's dolphins (CV = 0.27) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 2,199 Risso's dolphins.

Current Population Trend

No trend was identified in the annual abundance estimates. The 1994 abundance estimate was greater than the other annual estimates, but no annual estimates differed significantly using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991 (Hansen et al. 1995) or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates for this stock are not known; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. PBR for this stock is 22 Risso's dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of Risso's dolphins in the northern Gulf of Mexico is unknown. This species has been taken in the U.S. longline swordfish/tuna fishery in the northern Gulf of Mexico and in the U.S. Atlantic (Lee et al. 1994). Estimated average annual fishery-related mortality and serious injury attributable to the longline swordfish/tuna fishery in the Gulf of Mexico during 1992-1993 was 19 Risso's dolphins annually (CV = 0.20).

There were no documented strandings of Risso' dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total estimated fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, 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.

Fisheries Information

Interactions between the U.S. longline swordfish/tuna fishery and Risso' dolphins have been documented in the northern Gulf of Mexico (Lee et al. 1994). Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. One Risso's dolphin was observed taken and released alive during 1992; the extent of injury to the animal was unknown (SEFSC, unpublished data). One lethal take of a Risso's dolphin by the fishery was observed in the Gulf of Mexico during 1993 (SEFSC, unpublished data). Annual fishery-related mortality and incidental injury was estimated using a generalized linear model (Poisson error assumption) fit to the available observed incidental take data for the entire fishery and partitioned on the fishery effort (number of sets) in the Gulf of Mexico. Estimated total mortality and serious injury to Risso's dolphins (CV in parentheses) in the Gulf of Mexico in 1992 was 24 (0.19), and in 1993 it was 13 (0.20). Estimated average annual fishery-related mortality and serious injury attributable to the longline swordfish/tuna fishery in the Gulf of Mexico during 1992-1993 was 19 Risso's dolphins annually (CV = 0.20).

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown. This species is not listed under the Endangered Species Act and there are insufficient data to determine population trends. This is not a strategic stock because fishery-related mortality and serious injury does not exceed PBR; however, fishery-related mortality and serious injury is very close to PBR and requires close monitoring.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana, 108 pp.

SHORT-FINNED PILOT WHALE (*Globicephala macrorhynchus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The short-finned pilot whale is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983). Sightings of these animals in the northern Gulf of Mexico occur primarily along the continental shelf and continental slope [Mullin et al. 1991; Southeast Fisheries Science Center (SEFSC) unpublished data]. Short-finned pilot whales were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Davis et al., in preparation). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Abundance was estimated using distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Davis et al., in preparation). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range, so those data were not used for abundance estimation. Estimated abundance of short-finned pilot whales by survey year [coefficient of variation (CV) in parentheses] was zero in 1991, 909 in 1992 (0.62), 103 in 1993 (1.20), and 240 in 1994 (1.03) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of short-finned pilot whales for all surveys combined was 353 (CV = 0.89) (Hansen et al. 1995).

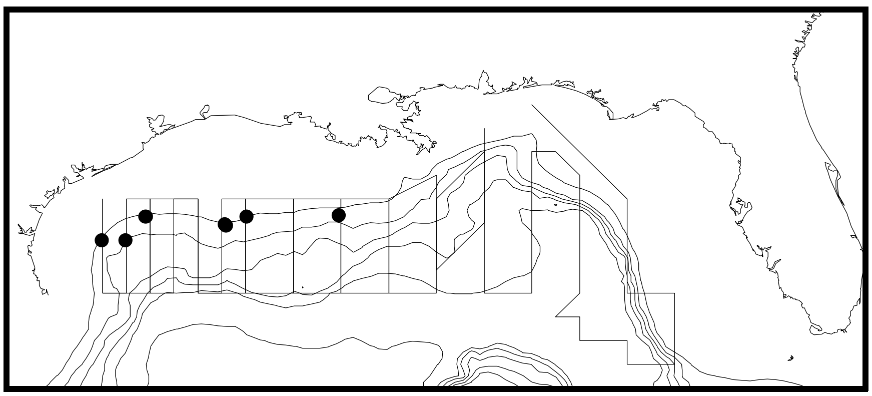


Figure 1. *Distribution of short-finned pilot whale sightings during NOAA Ship Oregon II surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average abundance estimate which was 353 pilot whales (CV = 0.89) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed average abundance estimate, which is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by NMFS (Anon. 1994). The minimum population estimate is 186 pilot whales.

Current Population Trend

The annual abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The variation in abundance estimates that was observed may have been caused by lower sampling effort during 1991, by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock; therefore, the default maximum net productivity rate of 0.04 (Anon. 1994) was used for purposes of this assessment.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) was specified as the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor for endangered, threatened, or depleted stocks, or stocks of unknown status relative to optimum sustainable population (OSP) (Anon. 1994). The recovery factor was set at 0.50 because the status of the stock relative to OSP is unknown. PBR for this stock is 1.9 short-finned pilot whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of short-finned pilot whales in the northern Gulf of Mexico is unknown. This species has been taken in the U.S. longline swordfish/tuna fishery in U.S. Atlantic waters (Lee et al. 1994) and there is a logbook report of a fishery-related mortality or serious injury in the northern Gulf of Mexico (NMFS unpublished data); however, fishery-related mortality or serious injury has not been observed. Total known fishery-related mortality or serious injury is estimated to be 0.3 short-finned pilot whales per year based upon the logbook report.

There were no documented strandings of short-finned pilot whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

The total known fishery-related mortality and serious injury for this stock is greater than 10% of the calculated PBR and, therefore, 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Interactions between the U.S. longline swordfish/tuna fishery and short-finned pilot whales have been reported in the northern Gulf of Mexico (SEFSC, unpublished logbook data), but have not been observed by NMFS fishery observers. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery was been monitored with about 5% observer coverage in both the Atlantic Ocean and the Gulf of Mexico, in terms of trips observed, in 1992-1993. There was one logbook report of a fishery-related injury of a pilot whale in the northern Gulf of Mexico in 1991, but no fishery interactions were observed during 1992-1993. Total known fishery-related mortality or serious injury is estimated to be 0.3 short-finned pilot whales per year based upon the logbook report.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total level of estimated fishery-related mortality and serious injury is unknown, but because there is a record of a fishery-related mortality or serious injury and because of the extremely low estimated stock size, this is a strategic stock.

REFERENCES

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.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. Distance Sampling: estimating abundance of biological populations. Chapman & Hall, London, 446 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp.

Davis, R., G. Scott, B. Würsig, W. Evans, G. Fargion, L. Hansen, K. Mullin, N. May, T. Leming, B. Mate, J. Norris and T. Jefferson. In preparation. Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final Report. OCS Study #MMS 94-0003. Texas Institute of Oceanography and the National Marine Fisheries Service. U.S. Dept. of the Interior, Minerals Mgmt. Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. + tables and figures.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado, 72 pp.

Leatherwood, S. and R. R. Reeves. 1983. The Sierra Club handbook of whales and dolphins. Sierra Club Books, San Francisco, 302 pp.

Lee, D. W., C. J. Brown, A. J. Catalano, J. R. Grubich, T. W. Greig, R. J. Miller and M. T. Judge. 1994. SEFSC pelagic longline observer program data summary for 1992-1993. NOAA Tech. Mem. NMFS-SEFSC-347, 19 pp.

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1991. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. OCS Study/MMS 91-0027. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana, 108 pp.

INDEX