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This report series represents a secondary level of scientifiic publishing. All issues employ thorough internal scientific review; some issues employ external scientific review. By design, reviews are transparent collegial reviews, not anonymous peer reviews. All issues may be cited in formal scientific communications.

U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 1999

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ABOUT THIS REPORT:

Report History

This report is the fourth in a series compiling marine mammal stock assessments for U.S. Atlantic and Gulf of Mexico waters. The first report was issued in July 1995 as *NOAA Technical Memorandum NMFS-SEFSC*-363. Copies of that first report can be obtained from the NMFS Southeast Fisheries Science Center's headquarters (75 Virginia Beach Dr., Miami, FL 33149-1003; 305-361-4284). The second report was issued in October 1997 as *NOAA Technical Memorandum NMFS-NE*-114. The third report, which included stock assessments only for U.S. Atlantic waters, was issued in February 1999 as *NOAA Technical Memorandum NMFS-NE*-116. Copies of the second and third reports, as well as copies of this report, can be obtained from the NMFS Northeast Fisheries Science Center's (NEFSC's) headquarters (166 Water St., Woods Hole, MA 02543-1026; 508-495-2000).

Editorial Treatment

To distribute this report quickly, it has not undergone the normal technical and copy editing by the NEFSC editor as have most other issues in the *NOAA Technical Memorandum NMFS-NE* series. Other than the four covers (inside and outside, front and back) and first two preliminary pages, all editing has been performed by – and all credit for such editing rightfully belongs to – the authors and those so noted in the "Acknowledgments" (page vi).

Species Names

The NMFS Northeast Region's policy on the use of species names in all technical communications is generally to follow the American Fisheries Society's (AFS) lists of scientific and common names for fishes (*i.e.*, Robins *et al.* 1991)[a], mollusks (*i.e.*, Turgeon *et al.* 1998)[b], and decapod crustaceans (*i.e.*, Williams *et al.* 1989)[c], and to follow the American Society of Mammalogists' list of scientific and common names for marine mammals (*i.e.*, Wilson and Reeder 1993)[d]. Exceptions to this policy occur when there are subsequent compelling revisions in the classifications of species, resulting in changes in the names of species (*e.g.*, Cooper and Chapleau 1998)[e].

[a]Robins, C.R. (chair); Bailey, R.M.; Bond, C.E.; Brooker, J.R.; Lachner, E.A.; Lea, R.N.; Scott, W.B. 1991. Common and scientific names of fishes from the United States and Canada. 5th ed. *Amer. Fish. Soc. Spec. Publ.* 20; 183 p.

[b]Turgeon, D.D. (chair); Quinn, J.F., Jr.; Bogan, A.E.; Coan, E.V.; Hochberg, F.G.; Lyons, W.G.; Mikkelsen, P.M.; Neves, R.J.; Roper, C.F.E.; Rosenberg, G.; Roth, B.; Scheltema, A.; Thompson, F.G.; Vecchione, M.; Williams, J.D. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks. 2nd ed. *Amer. Fish. Soc. Spec. Publ.* 26; 526 p.

[c]Williams, A.B. (chair); Abele, L.G.; Felder, D.L.; Hobbs, H.H., Jr.; Manning, R.B.; McLaughlin, P.A.; Pérez Farfante, I. 1989. Common and scientific names of aquatic invertebrates from the United States and Canada: decapod crustaceans. *Amer. Fish. Soc. Spec. Publ.* 17; 77 p.

[d]Rice, D.W. 1998. Marine mammals of the world: systematics and distribution. *Soc. Mar. Mammal. Spec. Publ.* 4; 231 p.

[e]Cooper, J.A.; Chapleau, F. 1998. Monophyly and interrelationships of the family Pleuronectidae (Pleuronectiformes), with a revised classification. *Fish. Bull. (U.S.)* 96:686-726.

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ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

Under the 1994 amendments of the Marine Mammal Protection Act (MMPA), the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) were required to generate stock assessment reports (SAR) for all marine mammal stocks in waters within the U.S. Exclusive Economic Zone (EEZ). The first reports for the Atlantic (includes the Gulf of Mexico) were published in July 1995 (Blaylock et al. 1995). The MMPA requires NMFS and USFWS to review these reports annually for strategic stocks of marine mammals and at least every 3 years for stocks determined to be non-strategic. The second edition of the SARs (1996 assessments) was published in October 1997 and contained all the previous reports, but major revisions and updating were only completed for strategic stocks (Waring et al. 1997). Updated reports were identified by a 1997 date-stamp at the top right corner at the beginning of each report. The 3rd edition of the SARs (1998 assessments) only contained reports for Atlantic stocks, and updated reports were identified by a 1998 date-stamp (Waring et al. 1999). The current report contains only updated assessments for Atlantic strategic stocks, and for Atlantic and Gulf of Mexico stocks for which significant new information was available. These reports are identified by a 1999 date-stamp at the beginning of each report.

This report was prepared by staff of the Northeast Fisheries Science Center (NEFSC), and Southeast Fisheries Science Center (SEFSC). NMFS staff presented the reports at the November 1998 meeting of the Atlantic Scientific Review Group (ASRG), and subsequent revisions were based on their contributions and constructive criticism.

Table 1 contains a summary, by species, of the information included in the stock assessments, and also indicates those that have been revised since the 1998 publication. A total of 28 of the 60 Atlantic and Gulf of Mexico stock assessment reports were revised for 1999. Most proposed changes incorporate new information into mortality estimates. The revised SARs include 14 strategic and 14 non-strategic stocks. Information on human interactions (fishery and ship strikes) between the North Atlantic right whale, North Atlantic humpback whale, and Canadian east coast minke whale stocks were re-reviewed and updated. The Western North Atlantic stocks of Atlantic spotted dolphin, pantropical spotted dolphin, and dwarf sperm whale are now considered "non-strategic" based on 5-year (1993-1997) annual estimates of incidental mortality in commercial fisheries. The Western North Atlantic stock of long-finned pilot whales was changed to "strategic" based on the annual incidental mortality estimate. Further, the stock definitions were changed for four Atlantic stocks (Sei whale, gray, harp and hooded seal) based on stock areas definitions used by international scientific organizations (i.e., IWC, ICES).

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. The authors solicit any new information or comments which would improve future stock assessment reports.

INTRODUCTION

Section 117 of the 1994 amendments to the Marine Mammal Protection Act (MMPA) requires that an annual stock assessment report (SAR) for each stock of marine mammals that occurs in waters under U.S. jurisdiction, be prepared by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS), in consultation with regional Scientific Review Groups (SRG). The SRGs are a broad representation of marine mammal and fishery scientists and members of the commercial fishing industry mandated to review the marine mammal stock assessments and provide advice to the Assistant Administrator for NMFS. The reports are then made available on the *Federal Register* for public review and comment before final publication.

The MMPA requires that each SAR contain several items, including: (1) a description of the stock, including its geographic range; (2) a minimum population estimate, a maximum net productivity rate, and a description of current population trend, including a description of the information upon which these are based; (3) an estimate of the annual human-caused mortality and serious injury of the stock, and, for a strategic stock, other factors that may be causing a decline or impeding recovery of the stock, including effects on marine mammal habitat and prey; (4) a description of the commercial fisheries that interact with the stock, including the estimated number of vessels actively participating in the fishery and the level of incidental mortality and serious injury of the stock by each fishery on an annual basis; (5) a statement categorizing the stock as strategic or not, and why; and (6) an estimate of the potential biological removal (PBR) level for the stock, describing the information used to calculate it. The MMPA also requires that SARs be updated annually for stocks which are specified as strategic stocks, or for which significant new information is available, and once every three years for nonstrategic stocks.

Following enactment of the 1994 amendments, the NMFS and FWS held a series of workshops to develop guidelines for preparing the SARs. The first set of stock assessments for the Atlantic Coast (including the Gulf of Mexico) were published in July 1995 in the *NOAA Technical Memorandum* series (Blaylock *et al*. 1995). In April 1996, the NMFS held a workshop to review proposed additions and revisions to the guidelines for preparing SARs (Wade and Angliss 1997). Guidelines developed at the workshop were followed in preparing the 1996 (Waring *et al*. 1997) and 1998 (Waring *et al*. 1999) SARs. A 1997 SAR was not produced.

In this document, major revisions and updating of the SARs were only completed for Atlantic Coast strategic stocks and Atlantic Coast and Gulf of Mexico stocks for which significant new information were available. These are identified by the 1999 date-stamp at the top right corner at the beginning of each report. The stock definitions were changed for four Atlantic stocks (Sei whale, gray, harp and hooded seal) based on stock areas definitions used by international scientific organizations (i.e., IWC, ICES).

Further, the status of three western North Atlantic stocks (Atlantic spotted dolphin, pantropical spotted dolphin, and dwarf sperm whale) were changed to non-strategic because the 5-year (1993-1997) mean annual mortalities in fishing operations were below PBR.

REFERENCES

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. Memo. NMFS-SEFSC-363, 211 pp.

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Waring, G. T., D. L. Palka, K. D. Mullin, J. H. W. Hain, L. J. Hansen, and K. D. Bisack. 1997. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments. NOAA Tech. Memo. NMFS-NE-114, 250 pp.

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

TABLE 1. A summary of Atlantic and Gulf of Mexico marine mammal stock assessment reports for stocks of marine mammals under NMFS authority that occupy waters under U.S. jurisdiction. (A "Y" under the heading "SAR revised" indicates which 1999 stock assessment reports have been revised relative to the 1998 reports.)

Species	Stock Area	SRG Region	NMFS Center	Nmin	Rmax	Fr	PBR	Total Annual Mort.	Annua l Fish. Mort.	Strategic Status	SAR Revised
Harbor seal	Western North Atlantic	ATL	NEC	30,990	0.12	1.0	1,859	943	943	N	Y
Gray seal	Western North Atlantic	ATL	NEC	NA	NA	NA	NA	67	67	N	Y
Harp seal	Western North Atlantic	ATL	NEC	N/A	N/A	N/A	N/A	383	383	N	Y
Hooded seal	Western North Atlantic	ATL	NEC	N/A	N/A	N/A	N/A	5.6	5.6	N	Y
Harbor porpoise	Gulf of Maine/Bay of Fundy	ATL	NEC	48,289	0.04	0.5	483	1,850	1,850	Y	Y
Risso's dolphin	Western North Atlantic	ATL	NEC	11,140	0.04	0.48	107	7.4	7.4	N	Y
Atlantic white-sided dolphin	Western North Atlantic	ATL	NEC	19,196	0.04	0.48	184	287	287	Y	Y
White-beaked dolphin	Western North Atlantic	ATL	NEC	N/A	0.04	N/A	N/A	0.00	0.00	N	N
Common dolphin	Western North Atlantic	ATL	NEC	16,060	0.04	0.48	154	780	780	Y	Y
Atlantic spotted dolphin	Western North Atlantic	ATL	NEC	1,617[1]	0.04	0.5	16	9.9[2]	9.9[2]	N	Y
Pantropical spotted dolphin	Western North Atlantic	ATL	NEC	1,617[1]	0.04	0.5	16	9.9[2]	9.9[2]	N	Y
Striped dolphin	Western North Atlantic	ATL	NEC	18,220	0.04	0.5	182	11	11	N	N

Species	Stock Area	SRG Region	NMFS Center	Nmin	Rmax	Fr	PBR	Total Annual Mort.	Annual Fish. Mort.	Strategic Status	SAR Revised
Spinner dolphin	Western North Atlantic	ATL	NEC	N/A	N/A	N/A	N/A	0.31	0.31	N	N
Bottlenose dolphin	Western North Atlantic, offshore	ATL	NEC	8,794[3]	0.04	0.5	88	10	10	N	Y
Bottlenose dolphin	Western North Atlantic, coastal	ATL	SEC	2,482	0.04	0.5	25	29	29	Y	Y
Dwarf sperm whale	Western North Atlantic	ATL	SEC	N/A	0.04	N/A	N/A	0.20	0.20	N	Y
Pygmy sperm whale	Western North Atlantic	ATL	SEC	N/A	0.04	N/A	N/A	0.00	0.00	N	Y
Killer whale	Western North Atlantic	ATL	NEC	N/A	0.04	N/A	N/A	0.00	0.00	N	N
Pygmy killer whale	Western North Atlantic	ATL	SEC	6	0.04	0.5	0.1	0.00	0.00	N	N
Northern bottlenose whale	Western North Atlantic	ATL	NEC	N/A	0.04	N/A	N/A	0.00	0.00	N	N
Cuvier's beaked whale	Western North Atlantic	ATL	NEC	895[4]	0.04	0.5	8.9	9.7	9.7[5]	Y	Y
Mesoplodon beaked whale	Western North Atlantic	ATL	NEC	895[4]	0.04	0.5	8.9	9.7	9.7[5]	Y	Y
Pilot whale, long-finned (Globicephala sp.)	Western North Atlantic	ATL	NEC	4,968[6]	0.04	0.45	45	40	40[7]	N	Y
Pilot whale, short-finned	Western North Atlantic	ATL	NEC	457	0.04	0.45	4.4	40	40[7]	Y	Y
Sperm whale	North Atlantic	ATL	NEC	1,617	0.04	0.1	3.2	0.00	0.00	Y	Y
North Atlantic right whale	Western North Atlantic	ATL	NEC	295	0.025	0.1	0.4	2.0	1.0[8]	Y	Y

Species	Stock Area	SRG Region	NMFS Center	Nmin	Rmax	Fr	PBR	Total Annual Mort.	Annual Fish. Mort.	Strategic Status	SAR Revised
Humpback whale	Western North Atlantic	ATL	NEC	10,019	0.065	0.1	32.6	4.4	3.2[9]	Y	Y
Fin whale	Western North Atlantic	ATL	NEC	1,803	0.04	0.1	3.6	0.6	0.20	Y	Y
Sei whale	Nova Scotia	ATL	NEC	N/A	0.04	0.1	N/A	0.00	0.00	Y	Y
Minke whale	Canadian east coast	ATL	NEC	2,145	0.04	0.5	21	5.8	4.8	N	Y
Blue whale	Western North Atlantic	ATL	NEC	308	0.04	0.1	0.6	0.00	0.00	Y	Y
Bottlenose dolphin	Gulf of Mexico bay, sound, and estuarine	ATL	SEC	3,933	0.04	0.5	39.7	N/A	N/A	Y	Y
Dwarf sperm whale	Northern Gulf of Mexico	ATL	SEC	N/A	0.04	N/A	N/A	0.00	0.00	N	Y
Pygmy sperm whale	Northern Gulf of Mexico	ATL	SEC	N/A	0.04	N/A	N/A	0.00	0.00	N	Y

1. This value includes either or both of *Stenella frontalis* or *Stenella attenuata*.

2. Mortality data are not separated by species; therefore, species-specific estimates are not available. The mortality estimate represents both Atlantic and Pantropical spotted dolphins.

3. Estimates may include sightings of the coastal form.

4. This estimate includes Cuvier's beaked whales and *Mesoplodon* spp. beaked whales.

5. This is the average mortality of beaked whales (*Mesoplodon* spp.) based on 5 years of observer data. This annual mortality rate includes an unknown number of Cuvier's beaked whales.

6. This estimate may include both long-finned and short-finned pilot whales.

7. Mortality data are not separated by species; therefore, species-specific estimates are not available. This mortality estimate represents both long-finned and short-finned pilot whales.

8. This is the average mortality of right whales based on 5 years of observer data (0.0) and additional fishery impact records (1.0).

9. This is the average mortality of humpback whales based on 5 years of observer data (0.6) and additional fishery impact records (2.6).

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Individuals of the western North Atlantic right whale population range from wintering and calving grounds in coastal waters of the southeastern United States to summer feeding, nursery, and presumed mating grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf. Knowlton *et al*. (1992) reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland, indicating an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described. Likewise, a calving and wintering ground has been described for coastal waters of the southeastern USA; sightings from the Gulf of Mexico (Moore and Clark 1963; Schmidly *et al*. 1972), are either geographic anomalies or indicate a more extensive historic range. Whichever the case, 85% of the population is unaccounted for during the winter. A small offshore survey effort in February 1996 reported three sightings in waters east of northeastern Florida and southeastern Georgia: a mother/calf pair, a single individual, and a group of four juveniles. These sightings suggest a distribution further offshore than previously reported.

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 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, including into deep water off the continental shelf (Mate *et al*. 1997). 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 copepods (largely of the genera *Calanus* and *Pseudocalanus*) in this area. Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently. These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitat (Kenney *et al*. 1986). Acceptable surface copepod resources are limited to perhaps 3% of the region during the peak feeding season in Cape Cod and Massachusetts Bays (Mayo and Goldman, pers. comm.). 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 are not well known. New England waters also serve as a nursery for calves and, in some cases, for mating.

Genetic analyses of tissue samples are providing insights into stock definition. Schaeff *et al*. (1993) used Restriction Fragment Length Polymorphism (RFLP) analysis to suggest that western North Atlantic right whales represent a single breeding population that may be based on as few as three matrilines. However, more recent analyses based upon direct sequencing of mitochondrial DNA (mtDNA) have identified five mtDNA haplotypes (Malik, 1997). Schaeff *et al*. (1997) compared the genetic variability of northern and southern (*E. australis*) right whales, and found the former to be significantly less diverse. They suggested that this might be indicative of inbreeding in the population, but no definitive conclusion can be reached using current data. Additional work comparing modern and historic genetic population structure in right whales, using DNA extracted from museum specimens of baleen and bone, is also underway (Rosenbaum *et al*. 1997). Preliminary results suggest that the eastern and western North Atlantic populations were not genetically distinct (Rosenbaum *et al*., submitted). However, the virtual extirpation of the eastern stock and its lack of recovery this century strongly suggests population subdivision over a protracted (but not evolutionary) timescale.

To date, skin biopsy sampling has resulted in the compilation of a DNA library of more than 200 North Atlantic right whales. When work is completed, a genetic profile will be established for each individual, and an assessment provided on the level of genetic variation in the population, the number of reproductive individuals, reproductive fitness, the basis for associations and social units in each habitat area, and the mating system. Tissue analysis has also aided in sex identification: the sex ratio of the photo-identified and catalogued population (through December of 1995) is 137 females and 132 males (1.04:1), not significantly different from parity ($P<0.001$) (M.W. Brown, pers. comm.). Analyses based on sighting histories of photographically identified individuals 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 additional wintering and summering grounds may exist in unsurveyed locations, although it is also possible that "missing" animals simply disperse over a wide area at these times.

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. However, no estimate of abundance with an associated coefficient of variation has been calculated for this population and its status remains uncertain (IWC 1998). Calculation of a reliable point estimate is likely to be difficult given the known problem of heterogeneity of distribution in this population.

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 USA lasted three centuries, and the records include one report of 29 whales killed in Cape Cod Bay in a single day during January 1700. Based on incomplete historical whaling data, 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. Based on back calculations using the present population size and growth rate, the population may have numbered fewer than 100 individuals by the time that international protection for right whales came into effect in 1935 (Hain 1975; Reeves *et al*. 1992; Kenney *et al*. 1995).

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 and presumed living whales represents a minimum population size estimate. The true population size in 1992 may have been higher if: 1) there were animals not photographed and identified, and/or 2) some animals presumed dead were not.

Current Population Trend

The population growth rate reported for the period 1986-92 by Knowlton *et al*. (1994) was 2.5% (CV = 0.12); this suggested that the stock was showing signs of slow recovery. However, work by Caswell *et al.* (1999) has suggested that crude survival probability declined from about 0.99 in the early 1980's to about 0.94 in the late 1990's. The decline was statistically significant, a finding which (if confirmed) is of grave concern. The impact of heterogeneity of capture on survival estimates remains unclear, and further research is urgently required; in addition, ongoing work by Caswell and colleagues, as well as by NMFS scientists, is incorporating age-specific factors into the survival analysis. As noted by the IWC (1998), determination of the status of this population is a high priority, notably in light of the known high levels of anthropogenic mortality in this population. The status and trends of the western North Atlantic right whale population will be addressed in an IWC workshop in October 1999.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

During 1980-1992, 145 calves were born to 65 identified cows. The number of calves born annually ranged from 5 to 17, with a mean of 11.2 (SE = 0.90). 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 statistically significant (P = 0.083) (Knowlton *et al*. 1994). Since that report, total reported calf production in 92/93 was 6; 93/94, 9; 94/95, 7; 95/96, 21; and 96/97, 19. The total calf production was reduced by reported calf mortalities: 2 mortalities in 1993, 3 in 1996, and 1 in 1997. Of the three calf mortalities in 1996, available data suggested one was not included in the reported 20 mother/calf pairs, resulting in a total of 21 calves born. Eleven of the 21 mothers in 1996 were observed with calves for the first time (i.e., were "new" mothers) that year. Three of these were 10 years old or younger, two were 9 years old, and six were of unknown age. In 95/96, more mothers gave birth after a 5-year interval than in previous years (L. Conger, pers. comm.). An updated analysis of calving interval through the 95/96 season suggests that calving interval is increasing (P<0.001) (R. Kenney and A. Knowlton, pers. comm.).

The annual population growth rate during 1986-1992 was estimated to be 2.5% (CV = 0.12) using photo-identification techniques (Knowlton *et al*. 1994). A population increase rate of 3.8% was estimated from the annual increase in aerial sighting rates in the Great South Channel, 1979-1989 (Kenney *et al*. 1995). 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). This difference could be attributable in part to reproductive females in the population--only 38% of the females in the North Atlantic population are known to have given birth compared with 54% in the western South Atlantic population (Brown *et al*. 1994). In addition, as noted above recent work has suggested that the population may be in decline (Caswell *et al.* 1999).

The relatively low population size indicates that this stock is well below its optimum sustainable population (OSP); therefore, the current population growth rate should reflect the maximum net productivity 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 productivity rate for this stock for purposes of this assessment. This rate is no longer current and may reflect underlying methodological problems; nonetheless, it is used here in the absence of better information because a risk-averse approach is appropriate for this critically endangered population. The alternative default rate of 0.04 is not species-specific and, being higher, is less conservative.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) was specified as the product of minimum population size, one-half the maximum net productivity rate (½ of 2.5%), and a "recovery" factor for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The recovery factor 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. If confirmed by ongoing work, the suggestion by Caswell *et al.* (1999) that the population is in decline will warrant a resetting to zero of the recovery factor in future SARs.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 1993 through 1997, the total estimated human-caused mortality and serious injury to right whales in USA waters is estimated as 2.0 per year. This is derived from two components: 1) non-observed fishery impact records, 1.0; and 2) ship strike records, 1.0. Note that in past stock assessment reports, a six-year time frame was used to calculate these averages. A five year period was used for this report to be consistent with the time frames used for calculating the averages for other species. It is also important to stress that serious injury determinations are made based upon the best available information; these determinations may change with the availability of new information.

Background

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 entanglement with fishing gear. An updated summary of right whale mortalities reports a total of 30 mortalities (29 if one eliminates a record with some doubt about species identification) for the period 1970 to early 1993 (Kenney and Kraus 1993). Eight (27%) were due to ship collisions, and two (7%) were due to entanglement with fishing gear. (Note that this report corrects one of the published records from the Kraus 1990 report, where a fishing vessel caught an already-dead carcass, making the actual cause of death unknown and possibly unrelated to fishing activity. Further, there was uncertainty about the species identification.) Both entanglements involved fixed fishing gear, and there was no evidence for right whale mortality from encounters with mobile fishing gear. The total of ten confirmed anthropogenic mortalities is one-third of all known mortalities for the period addressed. Young animals, ages 0-4 years, are apparently the most impacted portion of the population (Kraus 1990). Finally, entanglement or minor vessel collisions may not kill an animal directly, but may weaken or otherwise affect it so that it is more likely to become vulnerable. Such was apparently the case with the two-year old right whale killed by a ship off Amelia Island, Florida, in March 1991 after having carried gillnet gear wrapped around its tail region since the previous summer (Kenney and Kraus 1993).

For waters of the northeastern USA, a present concern, not yet completely defined, is the possibility of habitat degradation in Massachusetts and Cape Cod Bays due to a Boston sewage outfall now under construction. Timetables for levels of treatment are under discussion.

Awareness and mitigation programs for reducing anthropogenic injury and mortalities to right whales have been set up in two areas of concern. The first was initiated in 1992 off the coastal waters of the southeastern USA, and it has been upgraded and expanded annually. It involves both government and non-government organizations, including the Navy, Army Corps of Engineers, US Coast Guard, and Florida and Georgia state agencies. In 1996, a program was established in the northeastern USA, largely in cooperation with the US Coast Guard and the State of Massachusetts.

Fishery-Related Serious Injury and Mortality

Reports of mortality and serious injury relevant to calculation of PBR as well as total human impacts are contained in records maintained by the New England Aquarium and the Northeast Regional Office/NMFS (Table 1). From 1993-97, 5 of 10 records of mortality or serious injury involved entanglement or fishery interactions. The reports often do not contain the detail necessary to assign the entanglements to a particular fishery or location. However, based on re-examination of the records for the right whale observed entangled in pelagic drift gillnet in July 1993, which included the observer's documentation of lobster gear on the whale's tail stock and subsequent entanglement reports of this whale, the suspected mortality of this whale was reassigned to the Gulf of Maine and USA Mid-Atlantic lobster pot fisheries In this case, the pre-existing entanglement of lobster gear was judged to have been sufficient cause of eventual mortality independent of the drift net entanglement. Although some drift net gear was left on the tail by the fishing vessel, the entanglement in the drift net gear would likely not have occurred had the lobster gear not compromised the whale's mobility. In another instance, a 2 year-old dead male right whale with lobster line through the mouth and deeply embedded at the base of the right flipper beached in Rhode Island in July 1995. This individual had been sighted previously, entangled, east of Georgia in December 1993, and again in August 1994 in Cape Cod Bay. In this case, the entanglement became a serious injury, and, directly or indirectly, the cause of the mortality.

In January 1997 (62 FR 33, Jan. 2, 1997), NMFS changed the classification of the Gulf of Maine and USA Mid-Atlantic lobster pot fisheries from Category III to Category I based on examination of stranding and entanglement records of large whales from 1990 to 1994 (including the right whale records of 9 July 1993 and 17 July 1995, shown in Table 1).

Fishery Information

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year, several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks), and currently provides observer coverage of vessels fishing south of Cape Hatteras. By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in either the pelagic longline, pelagic pair trawl, or other fisheries monitored by NMFS. The only documented by-catch of a right whale by NMFS Sea Samplers was a 1½ year-old female that was released from a pelagic drift gillnet along the southern edge of Georges Bank (mentioned above). At the time of the release, it was discovered that the animal was also entangled in lobster gear. After recent review of the evidence, the serious injury to the whale has since been attributed to the non-observed Gulf of Maine and USA Mid-Atlantic lobster pot fisheries (see above).

In a recent analysis of the scarification of right whales, a total of 61.6% of the whales bore evidence of entanglements with fishing gear (Hamilton *et al*. 1998). Entanglement records maintained by NMFS Northeast Regional Office (NMFS, unpublished data) from 1970-1996, included 42 right whale entanglements or possible entanglements, including right whales in weirs, entangled in gillnets, and trailing line and buoys. An additional record (M. J. Harris, pers. comm.) reported a 9.1-10.6 m right whale entangled and released south of Ft. Pierce, Florida, in March 1982 (this event occurred in the course of a sampling program and was not related to a commercial fishery). Incidents of entanglements in groundfish gillnet gear, cod traps, and herring weirs in waters of Atlantic Canada and the USA east coast were summarized by Read (1994). In six records of right whales becoming entangled in groundfish gillnet gear in the Bay of Fundy and Gulf of Maine between 1975 and 1990, the right whales were either released or escaped on their own, although several whales have been observed carrying net or line fragments. A right whale mother and calf were released alive from a herring weir in the Bay of Fundy in 1976. For all areas, specific details of right whale entanglement in fishing gear are often lacking. When direct or indirect mortality occurs, some carcasses come ashore and are subsequently examined, or are reported as "floaters" at sea; however, the number of unreported and unexamined carcasses is unknown, but may be significant in the case of floaters. More information is needed about fisheries interactions and where they occur.

Other Mortality

Ship strikes are a major cause of mortality and injury to right whales (Kraus 1990). Records from 1993 through 1997 have been summarized in Table 1. For this time frame, the average reported mortality and serious injury to right whales due to ship strikes in USA waters was 1.0 whales per year.

In the period January to March 1996, an 'unusual mortality event' was declared for right whales in southeastern USA waters. Five mortalities were reported, at least one of which (on 1/30/96) was attributable to ship strike. A second mortality (on 2/22/96) showed evidence of barotrauma but no proximate cause of death could be determined. Of the remaining three mortalities, two were calves (1/2/96 and 2/19/96), one of which may have died from birthing trauma (inconclusive). The third (2/7/96) was decomposed and could not be towed in for examination. The five mortalities in the southeast were followed by a sixth at Cape Cod, Massachusetts (3/9/96); this involved an animal killed by ship strike, with the possibility that an existing entanglement (first reported in 1995) may have impeded its mobility.

Table 1. Summarized records of mortality and serious injury likely to result in mortality, North Atlantic right whales, January 1993 - December 1997. This listing includes only records related to USA commercial fisheries and/or USA waters. Causes of mortality or injury, assigned as primary or secondary, are based on records maintained by NMFS/NER and NMFS/SER.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary			Notes
				Ship strike	Entang./ Fsh.inter	Unknown uncertain	
1/5/93	mortality, offshore	calf	St. Augustine, FL	P			vessel reported striking whale, carcass recovered 1/8/93, deep propeller gashes
7/9/93	serious injury	1 y.o. female #2233	120 miles SE of Nantucket		P		lobster gear constricted on tail stock, subsequently became entangled in pelagic drift gillnet
12/6/93	mortality, offshore	female	offshore VA	P		S	photos show gash
2/22/94	serious injury	calf #2404	offshore NE FL	S	P		deep wounds from line or cable on head, probable propeller gashes on flukes
11/17/94	serious injury	3 y.o. juv., #2151	nr. Plum I., MA		P		line tightly wrapped around rostrum and deeply embedded in gums
7/17/95	mortality, beached	2 y.o. male #2366	Middletown, RI		P		lobster line through mouth, embedded deeply into bone at base of right flipper
8/13/95	serious injury, offshore	adult female, #1045	S. Georges Bank	P		S	large head wound exposing bone
1/30/96	mortality, offshore	adult male, #1623	offshore GA	P		S	shattered skull, broken vertebrae and ribs
3/9/96	mortality, beached	adult male #2220	Cape Cod MA	P	S		3.3 meter gash on back, broken skull, lobster line through mouth and around tail
8/5/96	serious injury	unknown	SE of Gloucester, MA		P		unknown type of gear entangled around head

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

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

With these caveats, the total estimated annual average human-induced mortality and serious injury within USA waters (including fishery and non-fishery related causes) was 2.0 right whales per year. As with entanglements, some injury or mortality due to ship strikes, particularly in offshore waters, may go undetected. Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or necropsied) represent 'lost data', some of which may relate to human impacts. For these reasons, the 2.0 estimate must be regarded as a minimum estimate.

While this assessment relates to USA fisheries and/or USA waters, there are additional records for Canadian waters within the same time frame. Six records are noteworthy: 1) whale #1247 was sighted 21 September 1994 in the Bay of Fundy entangled with line of an unknown gear type tightly wrapped around its tail stock and has not been sighted since--this is considered a serious injury (A.R. Knowlton, pers. comm.); 2) whale #2250 was found dead on Long Island, Nova Scotia, probably the result of a ship strike–it had a large gash on its back and broken vertebral disks; 3) whale #2220, which came ashore on Cape Cod on 9 March 1996, was entangled in Canadian lobster gear set in the Bay of Fundy and noticed missing in mid-December 1995--while the primary cause of death was probably a ship strike, the entanglement may have played some role in the whale's death; 4) whale #2450 was found dead in the Bay of Fundy on 19 August 1997--ship strike was identified as the cause; 5) whale #2212 was initially reported entangled in the Bay of Fundy on 23 August 1997, was mostly disentangled on 24 July 1998, but considered seriously injured due to subsequent evidence of it having ingested gear; and 6) whale # 2557, sighted on 29 August 1997, which was considered seriously injured due to line being tightly wrapped on the body, its emaciated appearance, and evidence of a necrotic left flipper.

In addition to these records, there was one Canadian record examined this year for which there was insufficient information to make a serious injury determination. This animal, #1705, was initially seen in mid-July 1997 in the Bay of Fundy with a small amount of line with several small, oval black buoys attached coming out of the right side of its mouth. The whale was also seen on 7/18/97, 8/25/97, and 9/6/97, still trailing the line and floats in each sighting. Although the injury resulting from the gear appeared minimal, it may have the potential to impair the animal's feeding. Future observations of the whale may provide an indication of whether the gear has resulted in serious injury.

Lastly, there was one USA record of a right whale serious injury that did not fall into the 1993-97 time frame, but is mentioned here since it was neglected in previous stock assessment reports. The whale was a juvenile sighted off the southeastern USA on 11 January 1992, apparently the victim of an entanglement. It had a long, deep gash on its fluke and entanglement scars on its tail. It appeared emaciated and in poor health.

STATUS OF STOCK

The size of this stock is considered to be low relative to OSP in the USA Atlantic EEZ, and this species is listed as endangered under the ESA. A Recovery Plan has been published and is in effect (NMFS 1991). Three critical habitats, Cape Cod Bay/Massachusetts Bay, Great South Channel, and the Southeastern USA, were designated by NMFS (59 FR 28793, June 3, 1994). The NMFS ESA 1996 Northern Right Whale Status Review concludes that the status of the western North Atlantic population of the northern right whale remains endangered. The total level of human-caused mortality and serious injury is unknown, but reported human-caused mortality and serious injury has been a minimum of 2.0 right whales per year since 1993. The total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching a zero mortality and serious injury rate. This is a strategic stock because the average annual fishery-related mortality and serious injury exceeds PBR, and because the North Atlantic right whale is an endangered species. Relative to other populations of right whales, there are also concerns about growth rate, percentage of reproductive females, and calving intervals in this population.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the western North Atlantic, humpback whales feed during spring, summer and fall over a range which encompasses the eastern coast of the United States (including the Gulf of Maine), the Gulf of St Lawrence, Newfoundland/Labrador, and western Greenland (Katona and Beard, 1990). Other North Atlantic feeding grounds occur off Iceland and northern Norway, including off Bear Island and Jan Mayen (Christensen *et al*., 1992; Palsbøll *et al*., 1997). These six regions represent relatively discrete subpopulations, fidelity to which is determined matrilineally (Clapham and Mayo 1987). Recent genetic analysis of mitochondrial DNA (mtDNA) has indicated that this fidelity has persisted over an evolutionary timescale in at least the Icelandic and Norwegian feeding grounds (Palsbøll *et al*. 1995, Larsen *et al*. 1996). Genetic partitioning is not evident in the western North Atlantic, however; thus these four subpopulations (Gulf of Maine, Gulf of St Lawrence, Newfoundland/Labrador and western Greenland) are treated as a single stock in this report. However, given that fidelity to each feeding area is known to be high, it is possible that each of the four regions should be managed separately, an approach which requires further investigation.

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

It is apparent that not all whales migrate to the West Indies every winter, and that significant numbers of animals are found in mid- and high-latitude regions at this time (Swingle *et al*. 1993, Clapham *et al*. 1993). An increased number of sightings of young humpback whales in the vicinity of the Chesapeake and Delaware bays occurred in 1992 (Swingle *et al*. 1993). Wiley *et al*. (1995) reported 38 humpback whale strandings which occurred during 1985-1992 in the USA mid-Atlantic and southeastern states. Humpback whale strandings increased, particularly along the Virginia and North Carolina coasts, and most stranded animals were sexually immature; in addition, the small size of many of these whales strongly suggests that they had only recently separated from their mothers. Wiley *et al*. (1995) concluded that these areas are becoming an increasingly important habitat for juvenile humpback whales and that anthropogenic factors may negatively impact whales in this area. There have also been a number of wintertime humpback sightings in coastal waters of the southeastern USA (NMFS unpublished data; New England Aquarium unpublished data; Florida DEP, unpublished data). Whether the increased sightings represent a distributional change, or are simply due to an increase in sighting effort and/or whale abundance, is presently unknown.

Feeding is the principal activity of humpback whales in New England waters, and their distribution in New England waters has been largely correlated to prey species and abundance, although behavior and bottom topography are factors in foraging strategy (Payne *et al*. 1986, 1990). Humpback whales are frequently piscivorus when in these waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes dubius*), and other small fishes. In the northern Gulf of Maine, euphausiids are also frequently taken (Paquet *et al*. 1997). Commercial depletion of herring and mackerel led to an increase in sand lance in the southwestern Gulf of Maine in the mid 1970s with a concurrent decrease in humpback whale abundance in the northern Gulf of Maine. Humpback whales were densest over the sandy shoals in the southwestern Gulf of Maine favored by the sand lance during much of the late 1970s and early 1980s, and humpback distribution appeared to have shifted to this area (Payne *et al*. 1986). An apparent reversal began in the mid 1980s, and herring and mackerel increased as sand lance again decreased (Fogarty *et al*. 1991). Humpback whale abundance in the northern Gulf of Maine increased dramatically during 1992-93 , along with a major influx of herring (P. Stevick, pers. comm.). Humpback whales were few in nearshore Massachusetts waters in the 1992-93 summer seasons. They were more abundant in the offshore waters of Cultivator Shoal and the Northeast Peak on Georges Bank, and on Jeffreys Ledge; these latter areas are more traditional locations of herring occurrence. In 1996 and 1997, sand lance, and thus humpback whales, were once again abundant in the Stellwagen Bank area. However, unlike previous cycles, where an increase in sand lance corresponded to a decrease in herring, herring remained relatively abundant in the northern Gulf of Maine, and humpbacks correspondingly continued to occupy this portion of the habitat, where they also fed on euphausiids (unpublished data, Center for Coastal Studies and College of the Atlantic).

In early 1992, a major research initiative known as the Years of the North Atlantic Humpback (YONAH) (Allen *et al*. 1993) was initiated. This project is a large-scale, intensive study of humpback whales throughout almost their entire North Atlantic range, from the West Indies to the Arctic. During two primary years of field work, photographs for individual identification and biopsy samples for genetic analysis were collected from summer feeding areas and from the breeding grounds in the West Indies. Additional samples were collected from certain areas in other years. Results pertaining to the estimation of abundance and to genetic population structure are summarized below.

POPULATION SIZE

The North Atlantic population was recently estimated from genetic tagging data collected by the YONAH project in the breeding range at 4,894 males (95% c.i. 3,374-7,123) and 2,804 females (95% c.i. 1,776-4,463) (Palsbøll *et al*. 1997). Since the sex ratio in this population is known to be even (Palsbøll *et al*. 1997), the excess of males is presumed to be a result of sampling bias, lower rates of migration among females or sex-specific habitat partitioning in the West Indies; whatever the reason, the combined total is an underestimate of overall population size in this ocean. Photographic mark-recapture analyses from the YONAH project gave an ocean-basin-wide estimate of 10,600 (95% c.i. 9,300 to 12,100), and an additional genotype-based analysis yielded a similar but less precise estimate of 10,400 (95% c.i. 8,000 to 13,600) (Smith *et al*. 1999). The estimate of 10,600 (CV = 0.067) is regarded as the best available estimate for the North Atlantic. In the northeastern North Atlantic, Øien (1990) estimated from sighting survey data that there were 1,100 humpback whales in the Barents Sea region.

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

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for North Atlantic humpback whales is 10,600 (CV = 0.067, Smith *et al*. 1999). The minimum population estimate for this stock is 10,019 humpback whales (CV=0.067).

Table 1. Summary of abundance estimates for North Atlantic humpback whales. Period and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV). MR = Mark-recapture.

Month/Year	Area	Type	N_{best}	CV	Source
spring/summer 1978-82	Cape Hatteras, NC to Nova Scotia	Transect	294	0.45	CETAP 1982
1979-90	N. Atlantic Ocean W and SW of Iceland	Photo MR	5,543	0.16	Katona *et al.* 1994
1992-93	N. Atlantic Ocean	Photo MR	10,600	0.067	Smith *et al.* 1999
1992-93	N. Atlantic Ocean	Genotype MR	10,400	0.138	Smith *et al.* 1999
1992-93	West Indies	Genotype MR	4,894 males 2,804 females	0.180 0.218	Palsbøll *et al.* 1997

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Katona and Beard (1990) suggest an annual rate of increase of 9%; however, the lower 95% confidence level was less than zero. The difference between the estimates of abundance calculated by Katona and Beard (1990) and by Smith *et al.* (1999) were interpreted by the latter as probably being due to population growth in the years between the two estimates. This assumed growth rate would be very similar to the growth rate of 6.5% calculated using an interbirth interval model for humpback whales in the Gulf of Maine (Barlow and Clapham 1997).

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

For purposes of this assessment, the maximum net productivity rate was set at 0.065, as calculated for the Gulf of Maine population by Barlow and Clapham (1997).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 10,019 (based on an estimate of abundance of 10,400 with a CV of 0.067). The maximum productivity rate is 0.065 from Barlow and Clapham (1997). The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because this stock is listed as an endangered species under the Endangered Species Act (ESA). PBR for the North Atlantic humpback whale stock is 32.6 whales.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 1993 through 1997, the total estimated human-caused mortality and serious injury to humpback whales is estimated as 4.4 per year. This average is derived from three components: 1) the 1993-1997 observed fishery, 0. 6; 2) additional fishery interaction records, 2.6; and 3) vessel collisions, 1.2. For the reasons described below, the additional records (from other than the observed fishery) cannot provide a quantitative estimate, but suggest that a number of additional serious injuries and mortalities do occur. Note that in past stock assessment reports, a six-year time frame was used to calculate the averages for additional fishery interactions and vessel collisions. A five year period was used for this report to be consistent with the time frames used for calculating the averages for the observed fishery and for other species. It is also important to stress that serious injury determinations are made based upon the best available information; these determinations may change with the availability of new information.

Background

As with right whales, human impacts (vessel collisions and entanglements) are factors which may be slowing recovery of the humpback whale population. There is an average of four to six entanglements of humpback whales a year in waters of the southern Gulf of Maine and additional reports of vessel-collision scars (unpublished data, Center for Coastal Studies). In addition, of 20 dead humpback whales, principally in the mid-Atlantic, where decomposition state did not preclude examination for human impacts, Wiley *et al*. (1995) reported that six (30%) had major injuries possibly attributable to ship strikes, and five (25%) had injuries consistent with possible entanglement in fishing gear. One whale displayed scars that may have been caused by both ship strike and entanglement. Thus, 60% of the whale carcasses which were suitable for examination showed signs that anthropogenic factors may have contributed to, or been responsible for, their death. Wiley *et al*. (1995) further reported that all stranded animals were sexually immature, suggesting a winter or migratory segregation and/or that juvenile animals are more susceptible to human impacts. Humpback whale entanglements also occur in relatively high numbers in Canadian waters. Reports of collisions with fixed fishing gear set for groundfish around Newfoundland averaged 365 annually from 1979 to 1987 (range 174-813). An average of 50 humpback whale entanglements (range 26-66) were reported annually between 1979 and 1988, and 12 of 66 humpback whales that were entangled in 1988 died (Lien *et al*. 1988). Volgenau *et al*. (1995) also summarized existing data and concluded that in Newfoundland and Labrador, cod traps caused the most entanglements and entanglement mortalities (21%) of humpbacks between 1979 and 1992. They also reported that gillnets are the gear that has been the primary cause of entanglements and entanglement mortalities (20%) of humpbacks in the Gulf of Maine between 1975 and 1990.

Fishery-Related Serious Injuries and Mortalities

Two mortalities were observed in the pelagic drift gillnet fishery since 1989. In winter 1993, a juvenile humpback was observed entangled dead in a pelagic drift gillnet along the 200 m isobath northeast of Cape Hatteras; in early summer 1995, a humpback was entangled and dead in a pelagic drift gillnet on southwestern Georges Bank (see below).

Additional reports of mortality and serious injury relevant to comparison to PBR, as well as description of total human impacts, are contained in records maintained by the Northeast Regional Office/NMFS. A number of these records (11 entanglements involving lobster gear) from the 1990-94 period were used in the 1997 List of Fisheries classification (62 FR 33, Jan. 2, 1997). For this report, the records of dead, injured, and/or entangled humpbacks (either found stranded or at sea) for the period 1993 to 1997 were reviewed. More than half of these records were eliminated from further consideration due to an absence of any evidence of human impact or, in the case of an entangled whale, it was documented that the animal had become disentangled. Of the remaining records, there was one mortality where fishery interaction was probable, and 12 records where serious injury attributable to fishery interaction was probable—for a total of 13 records in the five-year period (Table 3). While these records are not statistically quantifiable in the same way as the observed fishery records, they are suggestive of the frequency of entanglements.

Fishery Information

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras. By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in the pelagic longline, pelagic pair trawl, or other fisheries monitored by NMFS.

Pelagic Drift Gillnet

The estimated total number of hauls in the Atlantic pelagic drift gillnet fishery increased from 714 in 1989 to 1144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and 1996 were 233, 243, 232, 197, 164, and 149 respectively. In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine vessels participated in this fishery between 1989 and 1993. In 1994, 1995, and 1996 there were 12, 11, and 10 vessels, respectively, in the fishery (Table 2). Observer coverage (percent of sets observed) was 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. The greatest concentrations of effort were located along the southern edge of Georges Bank and off Cape Hatteras. Examination of the species composition of the catch and locations of the fishery throughout the year suggested that the drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, from 1989 to 1993, were obtained using the aggregated catch rates, by strata (Northridge 1996). Estimates of the total annual bycatch for 1994, 1995, and 1996 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in logbooks. Variances were estimated using bootstrap re-sampling techniques. Estimated annual mortality (CV in parentheses), extrapolated from fishery observer data, was 1.5 in 1993 (0.34), 0 in 1994 (0), 1.0 in 1995 (0), and 0 in 1996 (0). The total average annual estimated fishery-related mortality and serious injury in fisheries monitored by NMFS in 1993-1997 was 0.6 humpback whale (CV = 0.34) (Table 2).

In January 1997 (62 FR 33, Jan. 2, 1997), NMFS changed the classification of the Gulf of Maine and USA Mid-Atlantic lobster pot fisheries from Category III to Category I based on examination of stranding and entanglement records of large whales from 1990 to 1994 (including 11 serious injuries or mortalities of humpback whales).

Table 2. Summary of the incidental mortality of the humpback whale (*Megaptera novaeangliae*), by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

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

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

2 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. Mandatory logbook (Logbook) data are used to measure total effort, and the data are collected at the Southeast Fisheries Science Center (SEFSC).

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

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

5 One vessel was not observed and recorded 1 set in a 10 day trip in the SEFSC mandatory logbook. If you assume the vessel fished 1.4 sets per day as estimated from the 1995 SS data, the point estimate may increase by 0.08 animals. However, the SEFSC mandatory logbook data were taken at face value, and therefore it was assumed that 1 set was fished within this trip, and the point estimate would then increase by 0.01 animals.

Table 3. Summarized records of mortality and serious injury likely to result in mortality, North Atlantic humpback whales, January 1993 - December 1997. This listing includes only records related to USA commercial fisheries and/or USA waters. Cause of mortality or injury, assigned as primary or secondary, are based on records maintained by NMFS/NER and NMFS/SER.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary			Notes
				Ship strike	Entang./ Fsh.inter	Unknownu ncertain	
4/22/93	serious injury	age and sex unknown	4 mi SE of Province-town, Mass. (42• 01' 70• 06')		P		line around tail region and flukes, whale thin; unknown if gear trailing; same whale disentangled on 4/24/93??; thin and weak; healing around line
5/5/93	serious injury	age estimated 2-3 y.o.	NW part Stellwagen Bank (42• 26' 70• 27')		P		buoy warp wrapped around base of flipper; anchored and very fatigued; whale freed itself; unknown whether carrying gear
7/26/93	serious injury	unknown	30 mi SE of Bar Harbor, Maine (44• 00' 67• 38')		P		entangled; line wrapped around head and behind blowhole
8/8/93	serious injury	unknown	11 mi SE of Bar Harbor, Maine (44• 17' 68• 00')		P		net & buoys on head, dorsal fin, flippers; trailing gear; stressed behavior; cuts and blood reported, netting was removed, line remained on tail
10/7/93	serious injury	unknown	Atlantic City, New Jersey	P			boat collision with 33 ‘ sport fishing vessel; extent of injuries undetermined
7/14/94	serious injury	unknown	15 mi SE of Cape Elizabeth, Maine (43• 23' 68• 59')		P		CG helicopter crew reported animal with gillnet wrapped around head and swimming at surface
2/28/95	mortality	unknown	Cape Hatteras, North Carolina (35• 17' 75• 31')		P		stranded dead with gear wrapped around tail region

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary			Notes
				Ship strike	Entang./ Fsh.inter	Unknownu ncertain	
5/26/95	serious injury	length (est.) = 10 m	Great South Channel (41• 16' 69• 20')		P		net and monofilament around tail region; whale anchored; mesh visible and gear trailing
6/4/95	mortality	8.9 m male	Virginia Beach, Virginia	P			floater off inlet; lacerations along peduncle, probable ship strike
1/30/96	serious injury	juvenile	Northern Edge of Georges Bank (42• 26' 67• 30')		P		gear wrapped on body, some gear removed
2/22/96	serious injury	length (est.) = 8 m	Florida Keys		P		heavy line extending around maximum girth, pinning both pectorals; grooves/healed scars on dorsal ridge and on leading edge of both pectorals; fairly emaciated; disentangled
4/2/96	mortality	7.2 m female	Cape Story, Virginia Beach, Virginia	P			fresh dead; fractured left mandible; emaciated
5/9/96	mortality	6.7 m female	mouth of Delaware Bay	P			propeller cuts behind blowhole, moderate decomposition; ship strike
7/18/96	serious injury	length (est.) = 10 m	25 mi S of Bar Harbor Maine (44• 01' 68• 00')		P		disentanglement unsuccessful; weighted gear wrapped around tail stock; whale swimming abnormally
7/28/96	serious injury	length (est.) = 10m	SW corner of Stellwagen Bank, MA		P		entanglement involved mouth or flipper and line over tail; recent entanglement; extent of trailing gear unknown

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary			Notes
				Ship strike	Entang./ Fsh.inter	Unknownu ncertain	
10/7/96	serious Injury	unknown	Great South Channel (41• 04' 69• 10')		P		gear wrapped around tail and trailing 30 m behind whale
10/18/96	serious injury	unknown	Great South Channel (41• 00' 69• 10')		P		Whale entangled in steel cable
11/3/96	mortality	8.4 m male	Carrituck, North Carolina	P			acute trauma to skull found by necropsy
12/10/97	mortality	9.0 m male	Beaufort Inlet, North Carolina	P			massive hemorrhage consistent with forceful blunt trauma

Table notes:

1. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was reported beached, entangled, or injured.
2. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (62 FR 33, Jan. 2, 1997) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.
3. Assigned cause based on best judgement of available data. Additional information may result in revisions.
4. Entanglements of juvenile whales may become more serious as whale grows.
5. There is no overlap between tables 2 and 3 (the two records from the observed fishery are not included in Table 3).

Other Mortality

Between November 1987 and January 1988, 14 humpback whales died after consuming Atlantic mackerel containing a dinoflagellate saxitoxin. The whales subsequently stranded or were recovered in the vicinity of Cape Cod Bay and Nantucket Sound, and it is highly likely that other mortalities occurred during this event which went unrecorded. During the first six months of 1990, seven dead juvenile (7.6 to 9.1 m long) humpback whales stranded between North Carolina and New Jersey. The significance of these strandings is unknown, but is a cause for some concern.

As reported by Wiley *et al*. (1995) injuries possibly attributable to ship strikes are more common and perhaps more serious than those from entanglements. In the NER/NMFS records examined, several contained notes about wounds or probable/possible vessel collision. Five of these records were mortalities resulting from the collision. One record, on 7 October 1993, involving a 33 ft sport-fishing vessel, resulted in a serious injury to the whale.

To better assess human impacts (both vessel collision and net entanglement), and considering the number of decomposed and incompletely or unexamined animals in the records, there needs to be greater emphasis on the timely recovery of carcasses and complete necropsies. The literature and review of records described above suggest that there are significant human impacts beyond those in the fishery observer data. Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or necropsied) represent 'lost data', some of which may relate to human impacts. For these reasons, the human impacts listed in this report must be considered a minimum estimate.

STATUS OF STOCK

Although the most recent estimates of abundance indicate continued population growth, the size of the humpback whale stock may be below OSP in the USA Atlantic EEZ. This is a strategic stock because the humpback whale is listed as an endangered species under the ESA. A Recovery Plan has been published and is in effect (NMFS 1991). There are insufficient data to reliably determine population trends for humpback whales in the North Atlantic overall. The annual rate of population increase was estimated at 9% (Katona and Beard 1990, but with a lower 95% confidence level less than zero), and for the Gulf of Maine at 6.5% by Barlow and Clapham (1997). The total level of human-caused mortality and serious injury is unknown, but current data indicate that it is significant. The total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching a zero mortality and serious injury rate.

Disturbance by whalewatching may prove to be an important habitat issue in some areas of this population's range, notably the coastal waters of New England where the density of whalewatching traffic is seasonally high. No studies have been conducted to address this question, and its impact (if any) on habitat occupancy and reproductive success is unknown.

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October 1999

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Scientific Committee of the International Whaling Commission (IWC) has proposed stock boundaries for North Atlantic fin whales. Fin whales off the eastern USA, north to Nova Scotia and on to the 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, and whether the current stock boundaries define biologically isolated units has long been uncertain. The existence of a subpopulation structure was suggested by local depletions that resulted from commercial overharvesting (Mizroch *et al*. 1984).

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

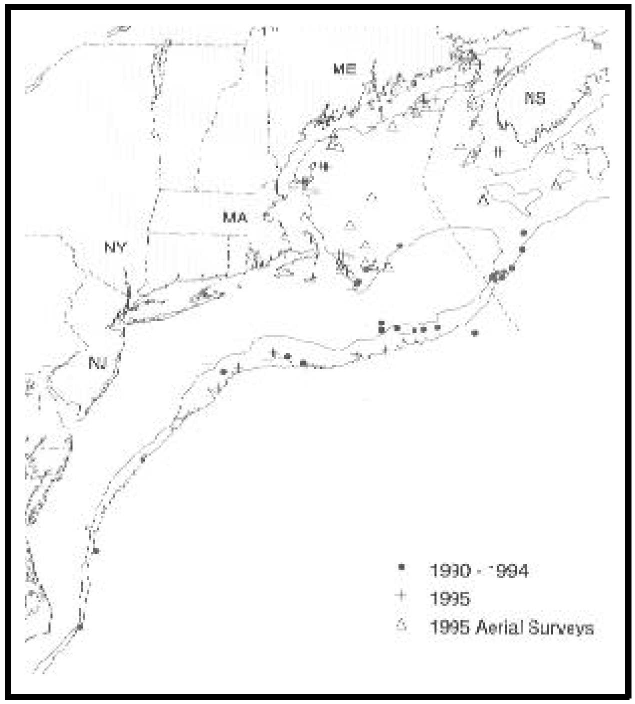

Figure 1. *Distribution of fin whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

Fin whales are common in waters of the USA Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward (Figure. 1). Fin whales accounted for 46% of the large whales and 24% of all cetaceans sighted over the continental shelf during aerial surveys (CETAP 1982) between Cape Hatteras and Nova Scotia during 1978-82. While a great deal remains unknown, the magnitude of the ecological role of the fin whale is impressive. In this region fin whales are the dominant large cetacean species in all seasons, with the largest standing stock, the largest food requirements, and therefore the largest impact on the ecosystem of any cetacean species (Hain *et al*. 1992).

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

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 USA 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 (Clark 1995) indicate a substantial deep-ocean component to fin whale distribution. It is likely that fin whales occurring in the USA Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions.

POPULATION SIZE

Five seasonal abundance estimates for fin whales are available for portions of the western North Atlantic during spring and summer of 1978-82, June-July 1991, August-September 1991, August-September 1991 and 1992, and July-September 1995 (Table 1; Figure 1).

A population size of 4,680 fin whales (CV=0.23) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). The estimate is based on an inverse variance weighted pooling of spring and summer data. An average of these seasons was chosen because the greatest proportion of the population off the northeast USA coast appeared in the study area during these seasons. This estimate includes a dive-time scale-up correction of 4.85 but does not correct for g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its old age and because it was estimated just after cessation of extensive foreign fishing operations in the region.

A population size of 35 (CV=0.56) fin whales was estimated from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Table 1; Waring *et al*. 1992). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but no corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 194 (CV=0.18) and 529 (CV=0.19) fin whales was estimated from line transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11, respectively (Table 1; Anon. 1991). The study area included that covered in the CETAP study plus several additional continental slope survey blocks. 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), where the CV was estimated using the bootstrap option. The abundance estimates do not include g(0) and were not pooled over platforms because the inter-platform calibration analysis has not been conducted.

A population size of 2,700 (CV=0.59) fin whales was estimated from two shipboard line transect surveys conducted during July to September 1991 and 1992 in the northern Gulf of Maine-lower Bay of Fundy region (Palka and Waring, unpublished data). This population size is a weighted-average of the 1991 and 1992 estimates, where each annual estimate was weighted by the inverse of its variance. The data were collected during surveys designed to estimate abundance of harbor porpoises (Palka 1995). Two independent teams of observers on the same ship surveyed using naked eye in non-closing mode. Using the product integral analytical method (Palka 1995) and DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993) the abundance includes an estimate of school size-bias, if applicable, and an estimate of g(0)–the probability of detecting a group on the track line–but no correction for dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 2,200 (CV=0.24) fin whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS/NEFSC unpublished data). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al.* 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey. An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time or ship avoidance. Variability was estimated using bootstrap re-sampling techniques.

The best available current abundance estimate for the western North Atlantic fin whale is 2,200 (CV=0.24) from the 1995 Virginia to Gulf of St Lawrence line transect surveys because it is relatively recent and covers the largest portion of the known habitat. However, this estimate must be considered conservative in view of the known range of the fin whale in the entire western North Atlantic, and uncertainties regarding population structure and exchange between surveyed and unsurveyed areas.

Table 1. Summary of abundance estimates for the western North Atlantic fin whale. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
spring & summer 1978-1982	Cape Hatteras, NC to Nova Scotia	4,680	0.23
Jun-Jul 1991	Cape Hatteras, NC to Georges Bank, shelf edge only	35	0.56
Aug-Sep 1991	Cape Hatteras, NC to Nova Scotia	194 and 529*	0.18 and 0.19*
Jul-Sep 1991 and 1992	N. Gulf of Maine and Bay of Fundy	2,700	0.59
Jul-Sept 1995	Virginia to the Gulf of St Lawrence	2,200	0.24

* From data collected on the Twin Otter and AT-11, respectively.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for fin whales is 2,200 (CV=0.24). The minimum population estimate for the western North Atlantic fin whale is 1803.

Current Population Trend

There are insufficient data to determine population trends for this species. Even at a conservatively estimated rate of increase, however, the numbers of fin whales may have increased substantially in recent years (Hain *et al*. 1992).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1803. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because the fin whale is listed as endangered under the Endangered Species Act (ESA). PBR for the western North Atlantic fin whale is 3.6.

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 1993-97. A review of NER/NMFS anecdotal records from 1993-1997 yielded an average of 0.6 human caused mortalities per year -- 0.2 per year resulting from fishery interactions/entanglements, and 0.4 due to vessel collisions.

Fishery-Related Serious Injury and Mortality

No confirmed 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. A review of the records of stranded, floating or injured fin whales for the period 1993-1997 on file at NER/NMFS found four records with evidence of fishery interactions. There was a live fin whale sighted entangled on 6/24/97 with line wrapped over its back. The animal appeared emaciated, but whether this was a result of the entanglement could not be determined. Two stranded fin whales had net or rope marks, but the evidence on hand was not sufficient to confirm entanglement as the cause of death. for these cases. The fourth record involved a whale that was found floating off Lubec, Maine, on 7/31/94. The whale had several wraps of line through the mouth, and about 30 wraps around the tail stock. This single confirmed entanglement mortality suggests an annual mortality of 0.2 fin whales from fishery interactions. While these records are not statistically quantifiable in the same way as the observed fishery records, they give a minimum estimate of the frequency of entanglements for this species.

Other Mortality

After reviewing NER/NMFS records, two were found that had sufficient information to confirm the cause of death as collisions with vessels. On 3/12/94, a 16-meter fin whale was found on Virginia Beach with fresh, deep propeller wounds in the caudal area. The animal's full stomach indicated it had been feeding not long before the collision. On 12/20/96, a fin whale was found floating near the shipping docks in Savannah, Georgia. The necropsy found bruising, coagulated blood, and broken ribs on the right side of the animal. NER/NMFS data holdings include seven additional records of fin whale mortalities that bore evidence of injury from collisions with vessels, but the available supporting documentation was not conclusive as to whether these constituted serious injury or were the proximal cause of the mortality.

STATUS OF STOCK

The status of this stock relative to OSP in the USA Atlantic EEZ 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 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. Any fishery-related mortality would be illegal because there is no recovery plan currently in place, although a draft plan is currently in review. This is a strategic stock because the fin whale is listed as an endangered species under the ESA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Indications are that, at least during the feeding season, a major portion of the 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 USA 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 (in 1987 and 1989) and Stellwagen Bank (in 1986) areas (R.D. Kenney, pers. comm.; Payne *et al*. 1990). An influx of sei whales into the southern Gulf of Maine occurred in the summer of 1986 (Schilling *et al*. 1993). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide.

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

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

POPULATION SIZE

The total number of sei whales in the USA Atlantic EEZ is unknown. However, two abundance estimates are available for portions of the sei whale habitat (Table 1): from Nova Scotia during the 1970's, and in the USA Atlantic EEZ during the spring of 1978-82.

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

A population size of 253 sei whales (CV=0.63) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). The estimate is based on data collected during the spring when the greatest proportion of the population off the northeast USA coast appeared in the study area. This estimate does not include a correction for dive-time or g(0), the probability of detecting an animal group on the track line. The CETAP report suggested, however, that correcting the estimated abundance for dive time would increase the estimate to approximately the same as Mitchell and Chapman's (1977) tag-recapture estimate. This estimate may not reflect the current true population size because of its high degree of uncertainty (e.g., large CV), its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region. There are no recent abundance estimates for the sei whale.

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

Month/Year	Area	N_{best}	CV
1966 - 1972	Nova Scotia, Canada	1,393 to 2,248	None reported
spring 1978-82	Cape Hatteras, NC to Nova Scotia	253	0.63

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). A current minimum population size cannot be estimated because there are no current abundance estimates (within the last 10 years).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are few if any data on fishery interactions or human impacts. There was no reported fishery-related mortality or serious injury to sei whales in fisheries observed by NMFS during 1993-1997. 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.

Fishery Information

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

STATUS OF STOCK

The status of this stock relative to OSP in the USA Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine the population trends for sei whales. The total level of human-caused mortality and serious injury is unknown, but the rarity of mortality reports for this species suggests that this level is insignificant and approaching a zero mortality and serious injury rate. 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.

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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). Individual identification has confirmed the movement of a blue whale between the Gulf of St Lawrence and western Greenland (R. Sears and F. Larsen, unpublished data), although the extent of exchange between these two areas remains unknown.

The blue whale is best considered as an occasional visitor in USA Atlantic Exclusive Economic Zone (EEZ) waters, which may represent the current southern limit of its feeding 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.

Using the U.S. Navy's SOSUS program, blue whales have been detected and tracked acoustically in much of the North Atlantic, including in subtropical waters north of the West Indies and in deep water east of the USA EEZ (Clark 1995). Most of the acoustic detections were around the Grand Banks area of Newfoundland and west of the British Isles. Sigurjónsson and Gunnlaugsson (1990) note that North Atlantic blue whales appear to have been depleted by commercial whaling to such an extent that they remain rare in some formerly important habitats, notably in the northern and northeastern North Atlantic.

POPULATION SIZE

Little is known about the population size of blue whales except for in the Gulf of St. Lawrence area. Here, 308 individuals have been catalogued (Sears *et al*. 1987), but the data were deemed to be unusable for abundance estimation (Hammond *et al*. 1990). Mitchell (1974) estimated that the blue whale population in the western North Atlantic may number only in the low hundreds. R. Sears (pers. comm.) 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 for the western North Atlantic stock.

Current Population Trend

There are insufficient data to determine population trends for this species. Off western and southwestern Iceland, an increasing trend of 4.9% a year was reported for the period 1969-1988 (Sigurjónsson and Gunnlaugsson 1990), although this estimate should be treated with caution given the effort biases underlying the sightings data on which it was based.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 308 (CV=unknown). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because the blue whale is listed as endangered under the Endangered Species Act (ESA). PBR for the western North Atlantic blue whale is 0.6.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no confirmed records of mortality or serious injury to blue whales in the USA Atlantic EEZ. However, in March 1998 a dead 66-foot male blue whale was brought into Rhode Island waters on the bow of tanker. The cause of death was determined to be ship strike, although it was unclear whether the tanker concerned killed the whale or merely picked up the carcass after death. The location of the strike was also not determined. Given the known rarity of blue whales in USA Atlantic waters, and the vessel's port of origin (Antwerp), it seems reasonable to suppose that the whale died somewhere to the north of the USA EEZ.

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 in the USA Atlantic EEZ 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 and approaching a zero mortality and serious injury rate. Any fishery-related mortality would be unlawful because there is no recovery plan currently in place, although a draft plan is currently in review. This is a strategic stock because the blue whale is listed as an endangered species under the ESA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

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

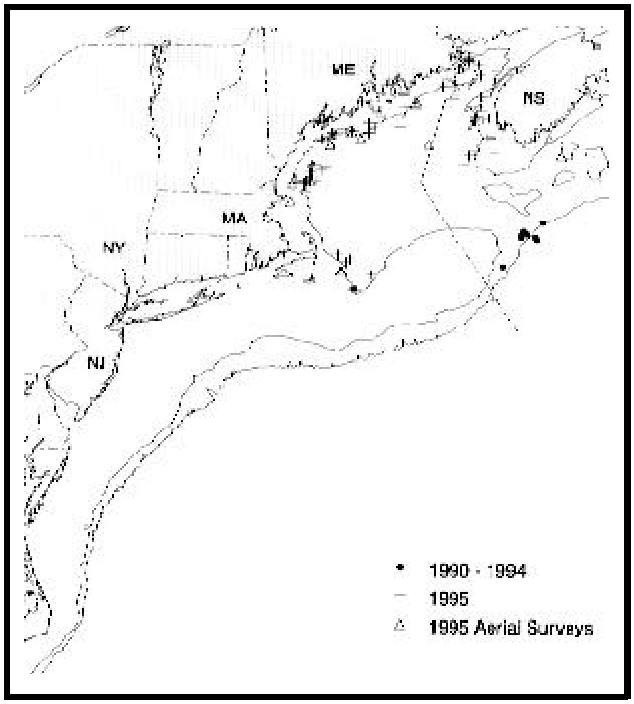

Figure 1. *Distribution of minke whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

The total number of minke whales in the Canadian East Coast population is unknown. However, four estimates are available for portions of the habitat — a 1978-1982 estimate, a shipboard survey estimate from the summers of 1991 and 1992, a shipboard estimate from June-July 1993, and an estimate made from a combination of a shipboard and aerial surveys conducted during July to September 1995 (Table 1; Figure 1).

A population size of 320 minke whales (CV=0.23) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). The estimate is based on spring data because the greatest proportion of the population off the northeast USA coast appeared in the study area during this season. This estimate does not include a correction for dive-time or g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

A population size of 2,650 (CV=0.31) minke whales was estimated from two shipboard line transect surveys conducted during July to September 1991 and 1992 in the northern Gulf of Maine-lower Bay of Fundy region (Table 1). This population size is a weighted-average of the 1991 and 1992 estimates, where each annual estimate was weighted by the inverse of its variance. The data were collected during surveys designed to estimate abundance of harbor porpoises (Palka 1995). Two independent teams of observers on the same ship surveyed using naked eye in non-closing mode. Using the product integral analytical method (Palka 1995) and DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993) the abundance included an estimate of school size-bias, if applicable, an estimate of g(0), probability of detecting a group on the track line, but no correction for dive-time or ship avoidance. Variability was estimated using bootstrap re-sampling techniques.

A population size of 330 minke whales (CV=0.66) was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Table 1; Anon. 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap re-sampling techniques.

A population size of 2,790 (CV=0.32) minke whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS/NEFSC unpublished data). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom depth contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom depth contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom depth contour line. This survey included the same region as that covered during the above 1991 and 1992 sighting surveys. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al.* 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and a belly window observer were used during the aerial survey (Palka 1996). An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time or platform avoidance. Variability was estimated using bootstrap re-sampling techniques. Minke whales were only detected in the Georges Bank - Gulf of Maine - Bay of Fundy region by one of the ships and the plane.

There are no estimates of abundance for this species in Canadian waters that lie farther north or east of the above survey's study area.

The best available current abundance estimate for minke whales is 2,790 (CV=0.32) as estimated from the July to September 1995 line transect surveys because this survey is recent and provided the most complete coverage of the known habitat.

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

Month/Year	Area	N_{best}	CV
spring 1978-82	Cape Hatteras, NC to Nova Scotia	320	0.23
Jul -Sep 1991-92	N. Gulf of Maine and Bay of Fundy	2,650	0.31
Jun-Jul 1993	Georges Bank to Scotian shelf, shelf edge only	330	0.66
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	2,790	0.32

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for minke whales is 2,790 (CV=0.32). The minimum population estimate for Canadian East Coast minke whale is 2,145 (CV=0.32).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 2,145 (CV=0.32). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the Canadian east coast minke whale is 21.

ANNUAL HUMAN-CAUSED MORTALITY AND INJURY

Data to estimate the mortality and serious injury of minke whales come from the USA Sea Sampling Program and from records of strandings and entanglements in USA waters. Estimates using the Sea Sampling Program data are discussed by fishery under the Fishery Information section below (Table 2). Strandings and entanglement records are discussed under "Unknown Fisheries" and the lobster trap fishery within the Fishery Information section and under the Other Mortality section (Tables 4 and 5).

After USA strandings and entanglement records are completely audited the mortality and serious injury estimate will be updated. Using the data presently available and audited, for 1993 to 1997, the USA total annual estimated average human-caused mortality is 5.8 minke whales per year. This is derived from three components: 1.1 minke whales per year (CV=0.0) from USA observed fisheries, 3.7 minke whales per year from USA fisheries not observed using strandings and entanglement data, and one ship strike in 1996.

Fishery Information

Recent minke whale takes have been observed in USA waters in the Atlantic pelagic drift gillnet, bluefin tuna purse seine, and Gulf of Maine and mid-Atlantic lobster trap/pot fisheries, and in fish weirs; though all takes have not resulted in a mortality (Tables 2 and 3).

USA

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fishery information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992, the SEFSC started observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) south of Cape Hatteras.

Earlier Interactions

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

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

Two minke whales were observed taken in the New England multispecies sink gillnet fishery between 1989 and the present. The take in July 1991, south of Penobscot Bay, Maine resulted in a mortality, and the take in October 1992, off the coast of New Hampshire near Jeffreys Ledge was released alive. There were approximately 349 vessels (full and part time) in the New England multispecies sink gillnet fishery in 1993 (Walden 1996). Observer coverage as a percentage of trips has been 1%, 6%, 7%, 5%, 7%, 5%, and 4%, and 6% for years 1990 to 1997. Because no mortalities have been observed within the most recent five years (1993 to 1997), the annual estimated average New England multispecies sink gillnet fishery-related mortality for minke whales is zero.

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

New England Multispecies Sink Gillnet

Because no interactions between minke whales and this fishery were observed within the most recent five years (1993 to 1997) this section was moved to the Earlier Interactions section above.

Pelagic Drift Gillnet

In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnet gear in the North Atlantic swordfish fishery (50 CFR Part 630). Four minke whale mortalities were observed in the Atlantic pelagic drift gillnet fishery during 1995 (Table 2). The estimated total number of hauls in the Atlantic pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995 and 1996 were 233, 243, 232, 197, 164, and 149 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994, 1995, and 1996 there were 12, 11 and 10 vessels, respectively, in the fishery (Table 2). Observer coverage, expressed as percent of sets, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996 (Table 2). Observer coverage dropped during 1996 because some vessels were deemed too small or unsafe by the contractor that provided observer coverage to NMFS. Fishing effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras. Examination of the species composition of the catch and locations of the fishery throughout the year, suggested that the drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, for each year from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 through 1996 were estimated separately for each year by summing the observed caught with the product of the average by-catch per haul and number of unobserved hauls as recorded in SEFSC logbooks. Variances were estimated using bootstrap re-sampling techniques. Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 0 for 1989 to 1994, 4.5 (0) for 1995, and 0 for 1996. The fishery was closed during 1997. Estimated average annual mortality and serious injury related to this fishery during 1993 to 1996 was 1.1 minke whales (CV=0.00) (Table 2).

Bluefin Tuna Purse Seine

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

Limited observer data are available for the bluefin tuna purse seine fishery. Out of 45 total trips made in 1996, 43 trips (95.6%) were observed. Forty-four sets were made on the 43 observed trips and all sets were observed. A total of 136 days were covered. No trips were observed during 1997.

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

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported seven minke whale mortalities and serious injuries that were attributed to the lobster fishery during 1990 to 1994, 1 in 1990 (may be serious injury), 2 in 1991 (one mortality and one a serious injury), 2 in 1992 (both mortalities), 1 in 1993 (serious injury) and 1 in 1994 (mortality) (1997 List of Fisheries 62FR33, January 2, 1997). Other than these records, only the 1997 entanglements have been completely audited. From the four 1997 records one minke whale mortality was attributed to the lobster trap fishery (Tables 4 and 5). The fishery attributing to the other three 1997 minke mortalities could not be determined (see unknown fisheries).

There are three distinctly identified stock areas for the American lobster: 1) Gulf of Maine, 2) South of Cape Cod to Long Island Sound, and 3) Georges Bank and South to Cape Hatteras. In 1997, there were 3,431 vessels holding licenses to harvest lobsters in federal waters, 2,674 vessels licensed to use lobster pot gear in state waters, 675 vessels licensed to use bottom trawls and approximately 100 licenses to use dredge gear to harvest lobsters. Lobsters are taken primarily by traps, with about 2-3% of the harvest being taken by mobile gear (trawlers and dredges). About 80% of lobsters are harvested from state waters. The offshore fishery in federal waters has developed in the past 10 to 15 years, largely due to technological improvements in equipment and lower competition in the offshore areas. In January 1997, NMFS changed the classification of the Gulf of Maine and USA Mid-Atlantic lobster pot fisheries from Category III to Category I (1997 List of Fisheries 62FR33, January 2, 1997) based on examination of 1990 to1994 stranding and entanglement records of large whales (including right whales, humpback and minke whales).

Annual mortalities due to this fishery, as determined from strandings and entanglement records that have been audited, were 1 in 1991, 2 in 1992, 1 in 1994, and 1 in 1997. Estimated average annual mortality related to this fishery during 1993 to 1997 (excluding 1995 and 1996 because data not audited) was 0.7 minke whales per year (Table 4). The mortality estimate will be updated when all strandings and entanglement records have been audited.

Unknown Fisheries

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, included 36 records of minke whales within USA waters for 1975-1992. The gear included unspecified fishing net, unspecified cable or line, fish trap, weirs, seines, gillnets, and lobster gear. A review of these records is not complete. One confirmed entanglement was an immature female minke whale, entangled with line around the tail stock that came ashore on the Jacksonville, Florida, jetty on 31 January 1990 (R. Bonde, USFWS, Gainesville, FL, pers. comm.). The NE Regional Office entanglement/stranding database for 1993 to 1997 also contains records of minke whales. However, at this time only the 1997 records have been audited (Tables 4 and 5). Other years will be available later. The examination of the minke entanglement records from 1997 indicate that 4 out of 4 records of mortality are likely a result of fishery interactions, one attributed to the lobster pot fishery (see above), and three could not be attributed to a particular fishery because the reports do not contain the necessary details.

In general, an entangled or stranded cetacean could be an animal that is part of a expanded by-catch estimate from an observed fishery and thus it is not possible to know if an entangled or stranded animal is an additional mortality. During 1997, there were no minke whales observed taken in any fishery that participated in the Sea Sampling Program, however, there were three confirmed minke whale mortalities due to some unknown fishery. Thus, for 1997, three is the best minimum estimate of mortality due to one or more fisheries.

CANADA

In Canadian waters, information about minke whale interactions with fishing gear is not well quantified or recorded, though some records are available. Read (1994) reported interactions between minke whales and gillnets in Newfoundland and Labrador, cod traps in Newfoundland, and herring weirs in the Bay of Fundy.

Herring Weirs

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. Due to the formation of a cooperative program between Canadian fishermen and biologists it is expected that now most minke whales will be able to be released alive (A. Westgate, pers. comm.).

In USA and Canadian waters the herring weir fishery occurred from May to September each year along the southwestern shore of the Bay of Fundy, and scattered along the western Nova Scotia and northern Maine coasts. In 1990 there were 180 active weirs in western Bay of Fundy (Read 1994). According to Canadian DFO officials, for 1998, there were 225 weir licenses for herring weirs on the New Brunswick and Nova Scotia sides of the Bay of Fundy (60 from Grand Manan Island, 95 from Deer and Campobello Islands, 30 from Passamaquoddy Bay, 35 from East Charlotte area, and 5 from the Saint John area). This number has been fairly consistent since 1985 (Ed Trippel, pers. comm.).

Other Fisheries

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

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

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

Table 2. Summary of the incidental mortality of minke whales (*Balaenoptera acutorostrata*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CV) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Drift Gillnet	93-97	1994=12[3] 1995=11 1996=10 1997=NA[6]	Obs. Data Logbook	.42, .87, .99, .64, NA[6]	0[4],0[4], 4[4],0[4], NA[6]	0[4], 0[4], 4.5[5], 0[4], NA[6]	0	1.1[6] (0)
TOTAL								1.1[6] (0)

1 Observer data (Obs. Data) are used to measure by-catch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. Mandatory logbook (Logbook) data are used to measure total effort for the pelagic drift gillnet fishery, and these data are collected at the Southeast Fisheries Science Center (SEFSC).

2 The unit of effort for the observer coverage of the pelagic drift gillnet fishery is percent of sets.

3 1994-1997 shown, other years not available on an annual basis.

4 For 1991-1993, pooled by-catch rates were used to estimate by-catch in months that had fishing effort but did not have observer coverage (Northridge 1996). After 1993, observer coverage increased substantially, and bycatch rates were annual rates (Bisack 1997). There was no fishery in 1997.

5 One vessel, not observed during 1995, recorded in the SEFSC mandatory logbook 1 set in a 10 day trip. If it is assumed that the vessel fished 1.4 sets per day, as estimated from the 1995 Sea Sampling data, the point estimate increases by 0.42 animals. However, the SEFSC mandatory logbook data were taken at face value, and therefore it was assumed 1 set was fished within this trip; thus the point estimate increases by 0.03 animals.

6 Fishery closed during 1997. So average by-catch is for 1993 to 1996.

Table 3. Summary of minke whales (*Balaenoptera acutorostrata*) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured).

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

NA=Not Available.

1 The minke whale escaped by diving beneath the net.

2 No observer coverage during 1997.

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

Fishery	Years	Vessels	Data Type [1]	Observed Mortality	Mean Annual Mortality
GOM and mid-Atlantic Lobster Trap/Pot	93-97	1997=6880 licenses[2]	Entanglement & Strandings	0,1,NA[3], NA[3],1	0.7[3] (0)
Unknown Fisheries	97	NA	Entanglement & Strandings	3	3 (0)
TOTAL					3.7 (0)

NA=Not Available.

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

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

3 1995 and 1996 stranding and entanglement records have not been audited, so average by-catch is an average of 1993, 1994 and 1997.

Table 5. Summary of audited records of mortality and serious injury likely to result in mortality for minke whales. This listing includes only records related to USA commercial fisheries and/or USA waters. Cause of mortality or injury, assigned as primary or secondary, based on records maintained by NMFS/NER and NMFS/SER.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary			Notes
				Ship strike	Entang./ Fsh.inter	Unknown uncertain	
7/2/94	mortality	NA	off NH		P		Lobster lines (3 pair traps involved; line through mouth; one line around lower jaw; chafing on tail; whale brought up dead with traps.
5/15/97	mortality	female 5.5m (est)	Gloucester, MA (42• 36 70• 38')		P		Deep lacerations around tail stock, abrasions around flukes and mouth
5/16/97	mortality	female 5.5m (est)	Rockport, MA (42• 40 70• 35')		P		Abrasions around flukes; feeding prior to entanglement
8/14/97	mortality	female 2.8m	Jewell Island, ME (43• 39' 70• 02')		P		Fresh lacerations on flukes and pectoral fins
8/30/97	mortality	female 8m (est)	Cape Small, ME (43• 40' 69• 57')		P		Observed entangled in lobster gear by ME Marine Patrol

Other Mortality

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

Minke whales inhabit coastal waters during much of the year and are subject to collision with vessels. According to the NE marine mammal entanglement and stranding database, on 7 July 1974, a necropsy on a minke whale suggested a vessel collision occurred; on 15 March 1992, a juvenile female minke whale with propeller scars was found floating east of the St. Johns channel entrance (R. Bonde, USFWS, Gainesville, FL, pers. comm.); and on 15 July 1996 the captain of a vessel reported they hit a minke whale offshore MA .

All entangled and stranded minke whales from 1993 to 1998 that had injuries suggestive of a vessel collision or fishery interactions will be audited and summarized in the next stock assessment report.

STATUS OF STOCK

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

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of the sperm whale in the USA EEZ occurs on the continental shelf edge, over the continental slope, and into mid-ocean regions (Figure 1). Waring *et al*. (1993) suggest that this offshore distribution is more commonly associated with the Gulf Stream edge and other features. However, the sperm whales that occur in the eastern USA EEZ likely represent only a fraction of the total stock. The nature of linkages of the USA habitat with those to the south, north, and offshore is unknown. Historical whaling records compiled by Schmidly (1981) suggested an offshore distribution off the southeast USA, over the Blake Plateau, and into 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). Whether the northwest Atlantic population is discrete from the northwestern or northeastern Atlantic is currently unresolved. The International Whaling Commission recognizes one stock for the North Atlantic. Based on a review of tagging and genetic studies, Reeves and Whitehead (1997) suggest that sperm whale populations have no clear geographic structure. There exists one tag return of a male tagged off Browns Bank (Nova Scotia) in 1966 and returned from Spain in 1973 (Mitchell 1975). Another male taken off northern Denmark in August 1981 had been wounded the previous summer by whales off the Azores (Reeves and Whitehead 1997).

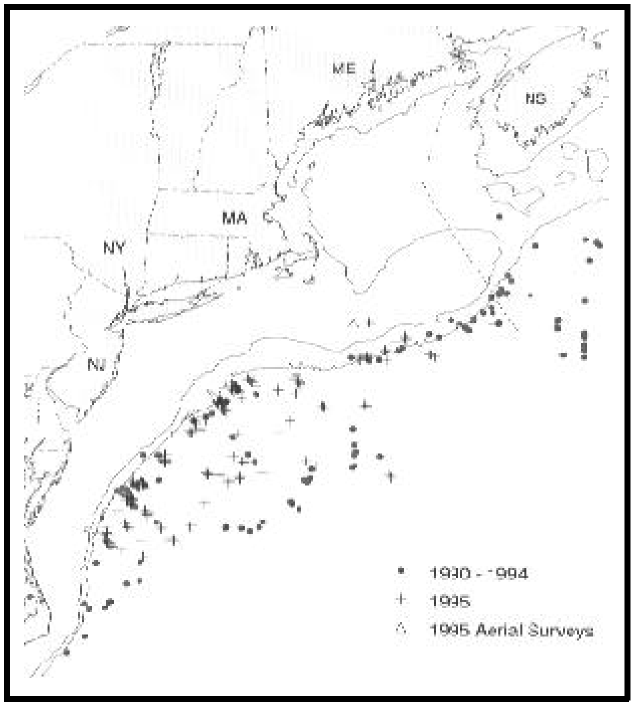

Figure 1. *Distribution of sperm whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

In the USA EEZ waters, there appears to be a distinct seasonal cycle (CETAP 1982; Scott and Sadove 1997). In winter, sperm whales are concentrated east and northeast of Cape Hatteras. In spring, the center of distribution shifts northward to east of Delaware and Virginia, 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 (inshore of the 100m isobath) 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. Similar inshore (<200m) observations have been made on the southwestern portion (Kenney pers. comm) and the eastern Scotian Shelf, particularly in the region of "the Gully" (Whitehead *et al*. 1991).

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; Whitehead *et al*. 1991). 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. Male sperm whales are present off and sometimes on the continental shelf along the entire east coast of Canada south of Hudson Strait, whereas, females rarely migrate north of the southern limit of the Canadian EEZ (Reeves and Whitehead 1997). However off the northeast U.S, CETAP and NMFS/NEFSC sightings in shelf-edge and off-shelf waters included many social groups with calves/juveniles (CETAP 1981; Waring *et al*. 1992, 1993). 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.

POPULATION SIZE

Total number of sperm whales off the USA or Canadian Atlantic coast are unknown, although seven estimates from selected regions of the habitat do exist for select time periods (Table 1): spring and summer of 1978-82, August 1990, June-July 1991, August-September 1991, June-July 1993, August 1994, and July-September 1995. These surveys were conducted in continental shelf edge and/or deeper oceanic waters. Sightings were almost exclusively in the continental shelf edge and continental slope areas (Figure 1).

A population size of 219 sperm whales (CV=0.36) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). The estimate is based on an inverse variance weighted pooling of spring and summer data. An average of these seasons were chosen because the greatest proportion of the population off the northeast USA coast appeared in the study area during these seasons. This estimate does not include corrections for dive-time or g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its high degree of uncertainty, its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

A population size of 338 (CV=0.31) sperm whales was estimated from an August 1990 shipboard line transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (Table 1; Anon. 1990; Waring *et al.* 1992). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 736 (CV=0.33) sperm whales was estimated from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Table 1; Waring *et al.* 1992; Waring 1998). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but no corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 705 (CV=0.66) and 337 (CV=0.50) sperm whales was estimated from line transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11, respectively (Table 1; Anon. 1991). The study area included that covered in the CETAP study plus several additional continental slope survey blocks. 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), where the CV was estimated using the bootstrap option. The abundance estimates do not include g(0) and were not pooled over platforms because the inter-platform calibration analysis has not been conducted.

A population size of 116 (CV=0.40) sperm whales was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Table 1; Anon. 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 623 (CV=0.52) sperm whales was estimated from an August 1994 shipboard line transect survey conducted within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank (Table 1; Anon. 1994). Data were collected by two alternating teams that searched with 25x150 binoculars and an independent observer who searched by naked eye from a separate platform on the bow. Data were analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 2,698 (CV=0.67) sperm whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS, unpublished data). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al.* 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey. An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time. Variability was estimated using bootstrap resampling techniques.

Because all the sperm whale estimates presented here were not corrected for dive-time, they are likely downwardly biased and an underestimate of actual abundance. Given that the average dive-time of sperm whales is approximately 45 min (Whitehead *et al*. 1991; Watkins *et al*. 1993), the bias may be substantial.

Although the stratification schemes used in the 1990-1995 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 USA coast. The collective 1990-95 data suggest that, seasonally, at least several hundred sperm whales are occupying these waters. The 1995 estimate is nearly eight-fold greater than 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.

The best available current abundance estimate for the western North Atlantic sperm whale is 2,698 (CV=0.67) as estimated from the July to September 1995 line transect survey (NMFS, unpublished data) because this survey is recent and provided the most complete coverage of continental shelf edge and continental slope waters off the northeast USA coast.

Table 1. Summary of abundance estimates for the western North Atlantic sperm whale. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
spring & summer 1978-82	Cape Hatteras, NC to Nova Scotia	219	0.36
Aug 1990	Gulf Stream	338	0.31
Jun-Jul 1991	Cape Hatteras, NC to Georges Bank, shelf edge only	736	0.33
Aug-Sep 1991	Cape Hatteras, NC to Nova Scotia	705 and 337*	0.66 and 0.50*
Jun-Jul 1993	Georges Bank to Scotian shelf, shelf edge only	116	0.40
Aug 1994	warm-core ring SE of Georges Bank	623	0.52
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	2,698	0.67

* From data collected on the Twin Otter and AT-11, respectively.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for sperm whales is 2,698 (CV=0.67). The minimum population estimate for the western North Atlantic sperm whale is 1,617 (CV=0.67).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. 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. These include: calving interval is 4-6 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 4.0 m, length at sexual maturity 11.0-12.5 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; Best *et al*. 1984).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,617 (CV=0.67). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because the sperm whale is listed as endangered under the Endangered Species Act (ESA). PBR for the western North Atlantic sperm whale is 3.2.

ANNUAL HUMAN-CAUSED MORTALITY

Four hundred twenty-four sperm whales were harvested in the Newfoundland-Labrador area between 1904-1972 and 109 male and no female sperm whales were taken near Nova Scotia in 1964-1972 (Mitchell and Kozicki 1984) in a Canadian whaling 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. 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.

Total annual estimated average fishery-related mortality or serious injury to this stock during 1993-1997 was zero sperm whales. Although, in 1995 one sperm whale was entangled in a pelagic drift gillnet and released alive with gear around several body parts. Presently, this injury has not been used to estimate mortality.

Fishery Information

Three sperm whale entanglements have been documented from August 1993 to May 1997. In August 1993, a dead sperm whale, with longline gear wound tightly around the jaw, was found floating about 20 miles off Mt Desert Rock. In October 1994, a sperm whale was successfully disentangled from a fine mesh gillnet in Birch Harbor, Maine. In May 1997, a sperm whale entangled in net with three buoys trailing was sighted 130 nm northwest of Bermuda. No information on the status of the animal was provided.

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and currently provides observer coverage of vessels fishing south of Cape Hatteras.

By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in the pelagic longline, pelagic pair trawl, New England multispecies sink gillnet, mid-Atlantic coastal sink gillnet, or North Atlantic bottom trawl observed fisheries.

Pelagic Drift Gillnet

Only two records exist in the present NEFSC by-catch database. In July 1990, a sperm whale was entangled and subsequently released (injured) from a pelagic drift gillnet near the continental shelf edge on southern Georges Bank. During June 1995, one sperm whale was entangled with "gear in/around several body parts" then released injured from a pelagic drift gillnet haul located on the shelf edge between Oceanographer and Hydrographer Canyons on Georges Bank.

The estimated total number of hauls in the pelagic drift net fishery increased from 714 in 1989 to 1144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and 1996 were 233, 243, 232, 197, 164, and 149 respectively. In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine vessels participated in this fishery between 1989 and 1993. Since 1994, between 10 to 12 vessels have participated in the fishery . Observer coverage, percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. The greatest concentrations of effort were located along the southern edge of Georges Bank and off Cape Hatteras. Examination of the species composition of the catch and locations of the fishery throughout the year, suggested that the pelagic drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of total by-catch, for each year from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata, assuming the 1990 injury was a mortality (Northridge 1996). 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 in 1991, 0 in 1992, 0 in 1993, 0 in 1994, 0 in 1995, 0 in 1996, and 0 in 1997. Estimated average annual mortality and serious injury related to this fishery during 1993-1997 was zero, assuming the 1995 injured sperm whale was not a serious injury. Table 2 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

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

Fishery	Years	Ratio	Injured[2]	Uninjured
Pelagic Drift Gillnet	93-97[3]	0, 0, 0, 0, NA	0, 0, 1[1],0, NA	0, 0, 0, 0, NA

[1] The observer recorded this animal being released alive and having the "gear in/around several body parts".
[2] Annual mortality estimates do not include any animals injured and released alive.
[3] The fishery did not operate in 1997.

Other Mortality

Ten sperm whale strandings have been documented along the USA Atlantic coast between Maine and Miami, Florida, during 1994-1996 (NMFS unpublished data).

In eastern Canada, five dead stranding were reported in Newfoundland/Labrador from 1987-1995; nine dead stranding along Nova Scotia from 1988-1991; seven dead stranding on Prince Edward Island from 1988-1991, and two dead strandings in Quebec in 1992 (Reeves and Whitehead 1997).

Ship strikes are another source of human induced mortality. In May 1994 a ship struck sperm whale was observed south of Nova Scotia (Reeves and Whitehead 1997).

STATUS OF STOCK

The status of this stock relative to OSP in USA Atlantic EEZ 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. Total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR. This is a strategic stock because the species is listed as endangered under the ESA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The dwarf sperm whale (*Kogia simus*) appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989). There are no stranding records for the east Canadian coast (Willis and Baird 1998). Sightings of these animals in the Western North Atlantic occur primarily along the continental shelf edge and over the deeper waters off the continental shelf (Hansen et al 1994 NMFS unpublished data). Dwarf sperm whales and pygmy sperm whales are difficult to distinguish and sightings of either species are often categorized as *Kogia* sp. There is no information on stock differentiation for the Atlantic population. In a recent study using hematological and stable-isotope data, Barros *et al*. (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales, and/or dive deeper during feeding bouts.

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 alone cannot be estimated due to uncertainty of species identification of sightings.

Minimum Population Estimate

A best and 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 for this species in the Western North Atlantic.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic dwarf sperm whale is unknown 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 fisheries interaction with dwarf sperm whales in the U.S. Atlantic EEZ.

Fishery Information

Data on current incidental takes in USA 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 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 pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in the pelagic longline, pelagic pair trawl, New England multispecies sink gillnet, mid-Atlantic coastal sink gillnet, and North Atlantic bottom trawl fisheries.

Pelagic Drift Gillnet

In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine different vessels participated in the pelagic drift gillnet fishery at one time or another between 1989 and 1993. In 1994 and 1995, respectively, there were 12 and 11 vessels in the fishery (Table 1). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994 and 99% in 1995. 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 pelagic drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. There was one report of mortality or serious injury to dwarf sperm whales attributable to this fishery. Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 0 dwarf sperm whales from 1991-1994, and 1.0 in 1995 (CV = 0); estimated average annual mortality and serious injury related to this fishery during 1993-1997 was 0.2 dwarf sperm whales (CV = 0) (Table 1).

Table 1. Summary of the incidental mortality of the dwarf sperm whale (*Kogia simus*), by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels [1]	Data Type [2]	Observer Coverage [3]	Observed Mortality	Estimated Mortality [4]	Estimated CVs-[4]	Mean Annual Mortality
Pelagic Drift Gillnet	93-97	1994=12 1995=11	Obs. Data Logbook	.42, .87, .99, .64, NA	0, 0, 1, 0, NA	0, 0, 1.0[4], 0, NA	0	0.2 (0)
TOTAL								0.2 (0)

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

2 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. Logbook (Logbook) data are used to measure total effort, and the data are collected at the Southeast Fisheries Science Center (SEFSC).

3 The observer coverage and unit of effort for the Pelagic Drift Gillnet is a set.

4 One vessel was not observed and recorded 1 set in a 10 day trip in the SEFSC mandatory logbook. If you assume the vessel fished 1.4 sets per day as estimated from the 1995 SS data, the point estimate may increase by 0.08 animals. However, the SEFSC mandatory logbook data was taken at face value, and therefore it was assumed that 1 set was fished within this trip, and the point estimate would then increase by 0.01 animals.

Other Mortality

Historical stranding records (1883-1988) of dwarf sperm whales in the southeastern USA (Credle 1988), and strandings recorded during 1988-1997 (Barros *et al.* 1998) indicate that this species accounts for about 17% of all *Kogia* strandings in this area. During the period 1990-October 1998, three dwarf sperm whale strandings occurred in the northeastern USA (Maryland, Massachusetts, and Rhode Island), whereas 43 strandings were documented along the USA Atlantic coast between North Carolina and the Florida

Keys in the same period. A pair of latex examination gloves was retrieved from the stomach of a dwarf sperm whale stranded in Miami in 1987 (Barros *et al*. 1990). In the period 1987-1994, one animal had possible propeller cuts on or near the flukes.

STATUS OF STOCK

The status of this stock relative to OSP in the USA Atlantic EEZ 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. It is not known whether total fishery-related mortality and serious injury for this stock is less than 10% of PBR and therefore cannot be considered insignificant and approaching zero mortality and serious injury rate, because PBR cannot be calculated.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy sperm whale (*Kogia breviceps*) appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989). Sightings of these animals in the Western North Atlantic occur primarily along the continental shelf edge and over the deeper waters off the continental shelf (Hansen et al 1994; 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* sp. There is no information on stock differentiation for the Atlantic population. In a recent study using hematological and stable-isotope data, Barros *et al.* (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales, and/or dive deeper during feeding bouts.

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 USA 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 alone cannot be estimated due to uncertainty of species identification of sightings.

Minimum Population Estimate

A best and 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 for this species in the Western North Atlantic.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic pygmy sperm whale was unknown because the minimum population estimate cannot be estimated.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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

There were no documented strandings of pygmy sperm whales along the USA 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.

Fishery Information

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reporting fisheries information system for large pelagic fisheries. The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program 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 have been no observed mortalities or serious injuries by NMFS Sea Samplers in the pelagic drift gillnet, pelagic longline, pelagic pair trawl, New England multispecies sink gillnet, mid-Atlantic coastal sink gillnet, and North Atlantic bottom trawl fisheries.

Other Mortality

Historical stranding records (1883-1988) of pygmy sperm whales in the southeastern USA (Credle 1988), and strandings recorded during 1988-1997 (Barros *et al.* 1998) indicate that this species accounts for about 83% of all *Kogia* strandings in this area. During the period 1990-October 1998, 21 pygmy sperm whale strandings occurred in the northeastern USA (Delaware, New Jersey, New York and Virginia), whereas 194 strandings were documented along the USA Atlantic coast between North Carolina and the Florida Keys in the same period. Remains of plastic bags and other marine debris have been retrieved from the stomachs of 13 stranded pygmy sperm whales in the southeastern USA (Barros *et al*. 1990, 1998), and at least on one occasion the ingestion of plastic debris is believed to have been the cause of death. During the period 1987-1994 one animal had possible propeller cuts on its flukes.

STATUS OF STOCK

The status of this stock relative to OSP in the USA Atlantic EEZ 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. It is not known whether total fishery-related mortality and serious injury for this stock is less than 10% of PBR and therefore, cannot be considered insignificant and approaching zero mortality and serious injury rate, because PBR cannot be calculated.

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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 USA 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 USA coast (CETAP 1982; Waring *et al*. 1992; NMFS unpubl. data). Most sightings were in late spring or summer. Based on sighting data, this species is a rare inhabitant of waters off the northeast USA coast (CETAP 1982).

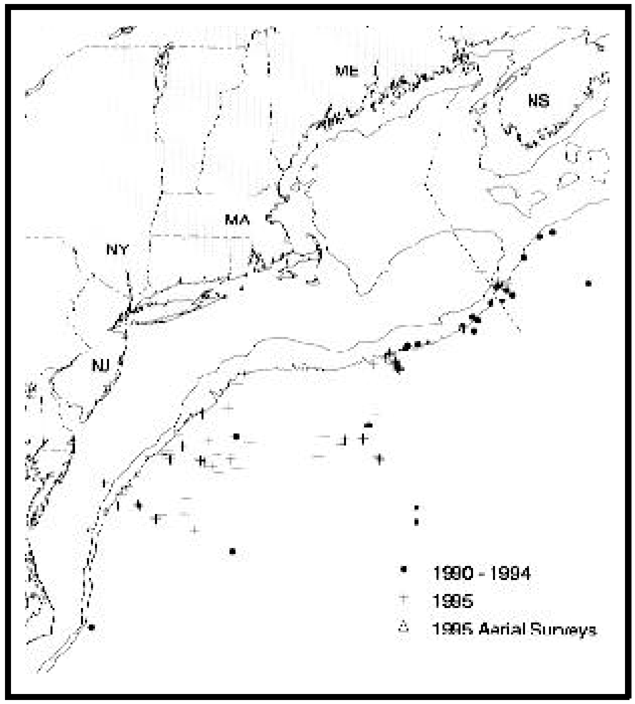

Figure 1. *Distribution of beaked whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

The total number of Cuvier's beaked whales off the eastern USA coast is unknown. However, seven estimates of the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is available from select regions of the habitat during summer 1978-82, August 1990, June-July 1991, August-September 1991, June-July 1993, August 1994, and July to September 1995 (Table 1; Figure 1).

A population size of 120 undifferentiated beaked whales (CV=0.71) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). The estimate is based on summer data because the greatest proportion of the population off the northeast USA coast appeared in the study area during this season. This estimate does not include corrections for dive-time or g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its high degree of uncertainty (e.g., large CV), its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

A population size of 442 (CV=0.51) undifferentiated beaked whales was estimated from an August 1990 shipboard line transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (Table 1; Waring *et al*. 1992). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 262 (CV=0.99) undifferentiated beaked whales was estimated from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Table 1; Waring *et al*. 1992; Waring 1998). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but no corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 370 (CV=0.65) and 612 (CV=0.73) undifferentiated beaked whales was estimated from line transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11, respectively (Table 1; Anon. 1991). The study area included that covered in the CETAP study plus several additional continental slope survey blocks. 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), where the CV was estimated using the bootstrap option. The abundance estimates do not include g(0) and were not pooled over platforms because the inter-platform calibration analysis has not been conducted.

A population size of 330 (CV=0.66) undifferentiated beaked whales was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Table 1; Anon. 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 99 (CV=0.64) undifferentiated beaked whales was estimated from an August 1994 shipboard line transect survey conducted within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank (Table 1; Anon. 1994). Data were collected by two alternating teams that searched with 25x150 binoculars and an independent observer who searched by naked eye from a separate platform on the bow. Data were analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 1,519 (CV=0.69) undifferentiated beaked whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS unpubl. data). Total track line length of this survey was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al*. 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey. An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time. Variability was estimated using bootstrap resampling techniques. Because the number of beaked whale sightings in each strata 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.

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.

The best available current abundance estimate for the undifferentiated complex of beaked whales is 1,519 (CV=0.69) as estimated from the July to September 1995 line transect survey (NMFS unpubl. data) because this survey provided the most complete coverage of the known habitat.

Table 1. Summary of abundance estimates for the undifferentiated complex of beaked whales which include *Ziphius* and *Mesoplodon* spp. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
summer 1978-82	Cape Hatteras, NC to Nova Scotia	120	0.71
Aug 1990	Gulf Stream	442	0.51
Jun-Jul 1991	Cape Hatteras, NC to Georges Bank, shelf edge only	262	0.99
Aug-Sep 1991	Cape Hatteras, NC to Nova Scotia	370 and 612*	0.65 and 0.73*
Jun-Jul 1993	Georges Bank to Scotian shelf, shelf edge only	330	0.66
Aug 1994	warm-core ring SE of Georges Bank	99	0.64
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	1,519	0.69

* From data collected on the Twin Otter and AT-11, respectively.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for undifferentiated beaked whales is 1,519 (CV=0.69). The minimum population estimate for the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 895 (CV=0.69). It is not possible to determine the minimum population estimate of only Cuvier's beaked 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 unknown for this stock. Life history parameters that could be used to estimate net productivity 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).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the undifferentiated complex of beaked whales is 895 (CV=0.69). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for all species in the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 8.9. It is not possible to determine the PBR for only Cuvier's beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 1993-1997 total average estimated annual fishery-related mortality of beaked whales in the USA EEZ was 9.7 (CV = 0.06).

Fishery Information

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

Current data on incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at 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 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files 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 USA 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 pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in the pelagic longline, pelagic pair trawl, New England multispecies sink gillnet, mid-Atlantic coastal sink gillnet, or North Atlantic bottom trawl observed fisheries.

The estimated total number of hauls in the pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and 1996 were 233, 243, 232, 197, 164, and 143, respectively. In 1996 and 1997, the NMFS issued management regulations with prohibited the operation of this fishery 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Since 1994, between 10-12 vessels have participated in the fishery (Table 2). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. 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 pelagic 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 from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 and 1995 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fisheries information. Variances were estimated using bootstrap re-sampling techniques. 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. Thirty-five fishery-related beaked whale mortalities were observed between 1989 and 1996. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.21), 76 in 1990 (0.26), 13 in 1991 (0.21), 9.7 in 1992 (0.24), 12 in 1993 (0.16) 4.8 in 1994 (0.08), 9.1 in 1995 (0), and 13 in 1996 (0.12) (Table 2). Annual mortality estimates do not include any animals injured and released alive. The 1993-1997 total average estimated annual fishery-related mortality of beaked whales in the USA EEZ was 9.7 (CV = 0.06) (Table 2). Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

Table 2. Summary of the incidental mortality for the undifferentiated complex of beaked whales which include Cuvier's beaked whale (*Ziphius cavirostris*), and *Mesoplodon* beaked whale, by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels [1]	Data Type [2]	Observer Coverage [3]	Observed Mortality	Estimated Mortality [4]	Estimated CVs [4]	Mean Annual Mortality
Pelagic Drift Gillnet	93-97[6]	1994=12 1995=11 1996=10	Obs. Data Logbook	.42, .87, .99, .64, NA	5, 4, 9, 8, NA	12, 4.8, 9.1[5], 13, NA	.16, .08, 0, .12, NA	9.7[6] (.06)
TOTAL								9.7 (.06)

1 1994 - 1996 shown, other years not available on an annual basis.
2 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. Mandatory logbook (Logbook) data are used to measure total effort, and the data are collected at the Southeast Fisheries Science Center (SEFSC).
3 The observer coverage and unit of effort for the Pelagic Drift Gillnet is a set.
4 For 1991-1993, pooled bycatch rates were used to estimate bycatch in months that had fishing effort but did not have observer coverage. This method is described in Northridge (1996). Because observer coverage increased substantially from 1994-1996, bycatch rates for this period are single year estimates.
5 One vessel was not observed and recorded 1 set in a 10 day trip in the SEFSC mandatory logbook. If you assume the vessel fished 1.4 sets per day as estimated from the 1995 SS data, the point estimate may increase by 0.8 animals. However, the SEFSC mandatory logbook data was taken at face value, and therefore it was assumed that 1 set was fished within this trip, and the point estimate would then increase by 0.1 animals.
6 The fishery did not operate in 1997; the average annual mortality is based on the number of years (4; 1993-1996) that the fishery operated.

Table 3. Summary for the undifferentiated complex of beaked whales which include Cuvier's beaked whales (*Ziphius cavirostris*) and *Mesoplodon* beaked whales released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured)

Fishery	Years	Ratio	Injured[1]	Uninjured
Pelagic Drift Gillnet	93-97[3]	5/12, 4/4.8, 9/9.1, 8/13, NA	0, 0, 1[2] 0, NA	0, 0, 0, 0, NA

1 Injured and released alive animals are not included in the Table 2 mortality estimates.
2 The observer recorded this animal being released alive and having the "gear in/around a single body part".
3 The fishery did not operate in 1997.

Other Mortality

From 1992-1997, a total of 32 beaked whales, 17 (includes one tentative identification) Gervais's beaked whales (one 1997 animal had plastics in esophagus and stomach, and Sargassum in esophagus); 2 True's beaked whales; 3 Blainville's beaked whales; 7 Cuvier's beaked whales (one 1996 animal showed signs of human interactions propeller marks) and 3 unidentified animals stranded along the USA Atlantic coast between Florida and Massachusetts (NMFS unpublished data).

STATUS OF STOCK

The status of Cuvier's beaked whale relative to OSP in USA Atlantic EEZ is unknown. This species is not listed as threatened or endangered under the Endangered Species Act. 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 970 in order for an annual mortality of 9.7 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 970 would be necessary for an annual mortality of 9.7 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 1,519 (CV = 0.69) which would result in a minimum population estimate of 895 beaked whales; however, this estimate does not include a correction factor for submerged animals which may be substantial. Although a species specific PBR cannot be determined, the total fishery mortality and serious injury for this group 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 is a strategic stock because of uncertainty regarding stock size and evidence of fishery-related mortality and serious injury.

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MESOPLODON BEAKED WHALES (*Mesoplodon* spp.): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the genus Mesoplodon, there are four species of beaked whales that reside 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. Stock structure for each species is unknown.

The distribution of *Mesoplodon* spp. in the northwest Atlantic is known principally from stranding records (Mead 1989; Nawojchik 1994). Off the northeast USA coast, beaked whale (*Mesoplodon* spp.) sightings have occurred principally along the southern edge of Georges Bank (CETAP, 1982; Waring *et al*. 1992; NMFS unpubl. data). Most sightings were in late spring and summer. In addition, beaked whales were also sighted in Gulf Stream features during NEFSC 1990-1995 surveys (Waring *et al*. 1992; Anon 1994; Tove 1995; NMFS unpubl. data).

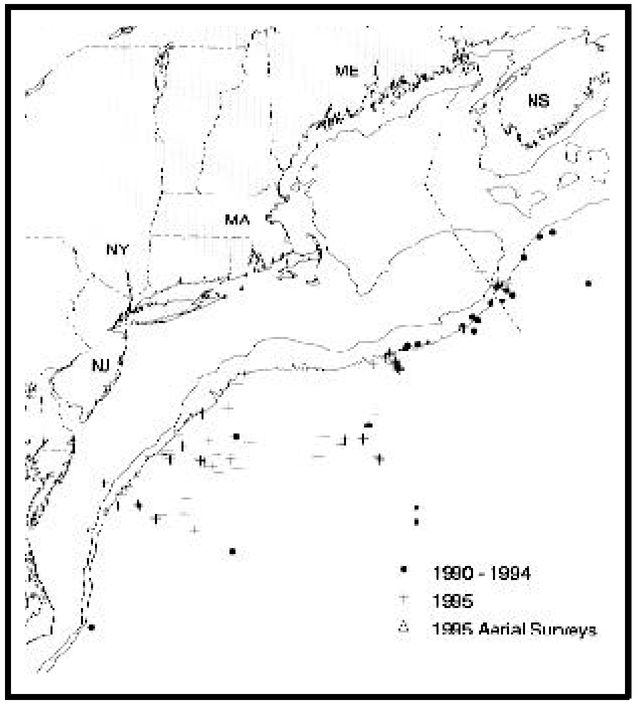

Figure 1. *Distribution of beaked whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

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 1990).

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 USA Atlantic coast. The northernmost stranding was off New York (Mead 1989).

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 1990).

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).

POPULATION SIZE

The total number of *Mesoplodon* spp. beaked whales off the eastern USA coast is unknown. However, seven estimates of the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is available from select regions of the habitat during summer 1978-82, August 1990, June-July 1991, August-September 1991, June-July 1993, August 1994, and July to September 1995 (Table 1; Figure 1).

A population size of 120 undifferentiated beaked whales (CV=0.71) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). The estimate is based on summer data because the greatest proportion of the population off the northeast USA coast appeared in the study area during this season. This estimate does not include corrections for dive-time or g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its high degree of uncertainty (e.g., large CV), its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

A population size of 442 (CV=0.51) undifferentiated beaked whales was estimated from an August 1990 shipboard line transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (Table 1; Waring *et al*. 1992). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 262 (CV=0.99) undifferentiated beaked whales was estimated from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Table 1; Waring *et al*. 1992; Waring 1998). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but no corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 370 (CV=0.65) and 612 (CV=0.73) undifferentiated beaked whales was estimated from line transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11, respectively (Table 1; Anon. 1991). The study area included that covered in the CETAP study plus several additional continental slope survey blocks. 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), where the CV was estimated using the bootstrap option. The abundance estimates do not include g(0) and were not pooled over platforms because the inter-platform calibration analysis has not been conducted.

A population size of 330 (CV=0.66) undifferentiated beaked whales was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Table 1; Anon. 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 99 (CV=0.64) undifferentiated beaked whales was estimated from an August 1994 shipboard line transect survey conducted within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank (Table 1; Anon. 1994). Data were collected by two alternating teams that searched with 25x150 binoculars and an independent observer who searched by naked eye from a separate platform on the bow. Data were analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 1,519 (CV=0.69) undifferentiated beaked whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS unpubl. data). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al*. 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey. An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time. Variability was estimated using bootstrap resampling techniques. 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 1990-1995 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 USA coast. The collective 1990-95 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.

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.

The best available current abundance estimate for the undifferentiated complex of beaked whales is 1,519 (CV=0.69) as estimated from the July to September 1995 line transect survey (NMFS unpubl. data) because this survey provided the most complete coverage of the known habitat.

Table 1. Summary of abundance estimates for the undifferentiated complex of beaked whales which include *Ziphius* and *Mesoplodon* spp. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
summer 1978-82	Cape Hatteras, NC to Nova Scotia	120	0.71
Aug 1990	Gulf Stream	442	0.51
Jun-Jul 1991	Cape Hatteras, NC to Georges Bank, shelf edge only	262	0.99
Aug-Sep 1991	Cape Hatteras, NC to Nova Scotia	370 and 612*	0.65 and 0.73*
Jun-Jul 1993	Georges Bank to Scotian shelf, shelf edge only	330	0.66
Aug 1994	warm-core ring SE of Georges Bank	99	0.64
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	1,519	0.69

* From data collected on the Twin Otter and AT-11, respectively.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for undifferentiated beaked whales is 1,519 (CV=0.69). The minimum population estimate for the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 895 (CV=0.69). It is not possible to determine the minimum population estimate of only Mesoplodont beaked 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 unknown for this stock. Life history parameters that could be used to estimate net productivity 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 (Mead 1984).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the undifferentiated complex of beaked whales is 895 (CV=0.69). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for all species in the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 8.9. It is not possible to determine the PBR for only *Mesoplodon* beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 1993-1997 total average estimated annual fishery-related mortality of beaked whales in the USA EEZ was 9.7 (CV = 0.06).

Fishery Information

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

Current data on incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993 the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and currently provides observer coverage of vessels fishing south of Cape Hatteras.

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 USA 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 pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in the pelagic longline, pelagic trawl, New England multispecies sink gillnet, mid-Atlantic coastal sink gillnet, or North Atlantic bottom trawl observed fisheries.

The estimated total number of hauls in the pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and 1996 were 233, 243, 232, 197, 164, and 143, respectively. In 1996 and 1997, the NMFS issued management regulations with prohibited the operation of this fishery 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Since 1994, between 10-12 vessels have participated in the fishery (Table 2). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. 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 pelagic 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 from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 and 1995 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fisheries information. Variances were estimated using bootstrap re-sampling techniques. 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. Thirty-five fishery-related beaked whale mortalities were observed between 1989 and 1996. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.21), 76 in 1990 (0.26), 13 in 1991 (0.21), 9.7 in 1992 (0.24), 12 in 1993 (0.16) 4.8 in 1994 (0.08), 9.1 in 1995 (0), and 13 in 1996 (0.12) (Table 2). Annual mortality estimates do not include any animals injured and released alive. The 1993-1997 total average estimated annual fishery-related mortality of beaked whales in the USA EEZ was 9.7 (CV = 0.06) (Table 2). Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

Table 2. Summary of the incidental mortality for the undifferentiated complex of beaked whales which include Cuvier's beaked whale (*Ziphius cavirostris*), and *Mesoplodon* beaked whale, by commercial fishery including the years sampled (Years),

the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels [1]	Data Type [2]	Observer Coverage [3]	Observed Mortality	Estimated Mortality [4]	Estimated CVs [4]	Mean Annual Mortality
Pelagic Drift Gillnet	93-97[6]	1994=12 1995=11 1996=10	Obs. Data Logbook	.42, .87, .99, .64, NA	5, 4, 9, 8, NA	12, 4.8, 9.1[5], 13, NA	.16, .08, 0, .12, NA	9.7[6] (.06)
TOTAL								9.7 (.06)

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

2 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. Mandatory logbook (Logbook) data are used to measure total effort, and the data are collected at the Southeast Fisheries Science Center (SEFSC).

3 The observer coverage and unit of effort for the Pelagic Drift Gillnet is a set.

4 For 1991-1993, pooled bycatch rates were used to estimate bycatch in months that had fishing effort but did not have observer coverage. This method is described in Northridge (1996). Because observer coverage increased substantially from 1994-1996, bycatch rates for this period are single year estimates.

5 One vessel was not observed and recorded 1 set in a 10 day trip in the SEFSC mandatory logbook. If you assume the vessel fished 1.4 sets per day as estimated from the 1995 SS data, the point estimate may increase by 0.8 animals. However, the SEFSC mandatory logbook data was taken at face value, and therefore it was assumed that 1 set was fished within this trip, and the point estimate would then increase by 0.1 animals.

6 The fishery did not operate in 1997; the average mortality is based on the number of years (4; 1993-1996) that the fishery operated.

Table 3. Summary for the undifferentiated complex of beaked whales which include Cuvier's Beak Whales (*Ziphius cavirostris*) and *Mesoplodon* beaked whales released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured)

Fishery	Years	Ratio	Injured[1]	Uninjured
Pelagic Drift Gillnet	93-97[3]	5/12, 4/4.8, 9/9.1, 8/13, NA	0, 0, 1[2], 0, NA	0, 0, 0, 0, NA

1 Injured and released alive animals are not included in the Table 2 mortality estimates.

2 The observer recorded this animal being released alive and having the "gear in/around a single body part".

3 The fishery did not operate in 1997.

Other Mortality

From 1992-1997, a total of 32 beaked whales, 17 (includes one tentative identification) Gervais's beaked whales (one 1997 animal had plastics in esophagus and stomach, and Sargassum in esophagus); 2 True's beaked whales; 3 Blainville's beaked whales; 7 Cuvier's beaked whales (one 1996 animal showed signs of human interactions propeller marks) and 3 unidentified animals stranded along the USA Atlantic coast between Florida and Massachusetts (NMFS unpublished data).

STATUS OF STOCK

The status of Mesoplodont beaked whales relative to OSP in USA Atlantic EEZ is unknown. These species are not listed as threatened or endangered under the Endangered Species Act. 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 970 in order for an annual mortality of 9.7 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 970 would be necessary for an annual mortality of 9.7 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 1,519 (CV = 0.69), which would result in a minimum population estimate of 895 beaked whales; however, this estimate does not include a correction factor for submerged animals which may be substantial. Although a species specific PBR cannot be determined, the total fishery mortality and serious injury for this group 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 is a strategic stock because of uncertainty regarding stock size and evidence of fishery-related mortality and serious injury.

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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 USA 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 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 had sightings of Risso's dolphins 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 USA and Canadian Atlantic coast is unknown, although four estimates are available from selected regions during spring and summer 1978-82, June-July 1991, August-September 1991, and June-July 1993.

A population size of 4,980 (CV = 0.34) Risso's dolphins was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). The estimate is based on an inverse variance weighted pooling of spring and summer data. An average of these seasons were chosen because the greatest proportion of the population off the northeast USA coast appeared in the study area during these seasons. This estimate does not include a correction for dive-time or g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

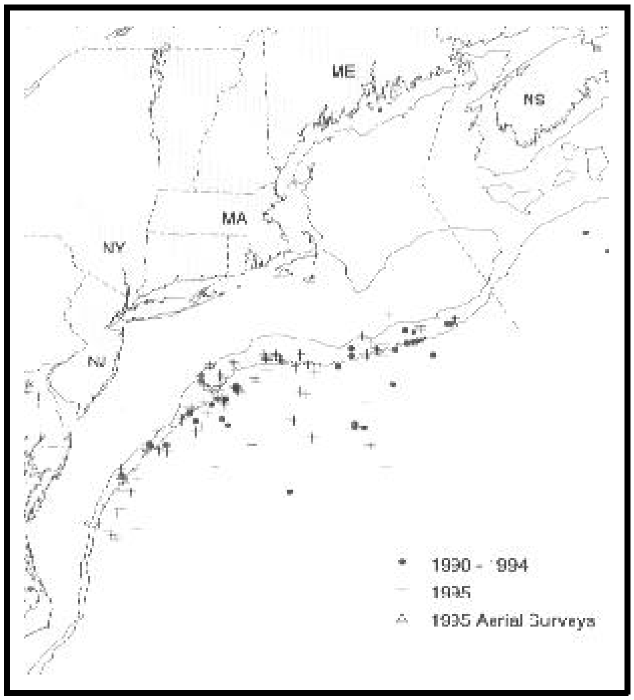

Figure 1. *Distribution of Risso's dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

A population size of 11,017 (CV=0.58) Risso's dolphins was estimated from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Table 1; Waring *et al.* 1992; Waring 1998). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but no corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 6,496 (CV=0.74) and 16,818 (CV=0.52) Risso's dolphins was estimated from line transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11, respectively (Table 1; Anon. 1991). The study area included that covered in the CETAP study plus several additional continental slope survey blocks. 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), where the CV was estimated using the bootstrap option. The abundance estimates do not include g(0) and were not pooled over platforms because the inter-platform calibration analysis has not been conducted.

A population size of 212 (CV=0.62) Risso's dolphins was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Table 1; Anon. 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

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; Anon. 1994).

A population size of 5,587 (CV=1.16) Risso's dolphins was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS unpublished data). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al.* 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey. An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time. Variability was estimated using bootstrap resampling techniques.

Although the 1991, 1993, and 1995 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 USA 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.

The best available current abundance estimate for Risso's dolphins is 16,818 (CV=0.52) as estimated from the August to September 1991 aerial line transect survey in the AT-11 because this survey provided the most complete coverage of the known habitat.

Table 1. Summary of abundance estimates for the western North Atlantic Risso's dolphin. Month, year, and area covered during each abundance survey, resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
spring & summer 1978-82	Cape Hatteras, NC to Nova Scotia	4,980	0.34
Jun-Jul 1991	Cape Hatteras, NC to Georges Bank, shelf edge only	11,017	0.58
Aug-Sep 1991	Cape Hatteras, NC to Nova Scotia	6,496 and 16,818*	0.74 and 0.52*
Jun-Jul 1993	Georges Bank to Scotian shelf, shelf edge only	212	0.62
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	5587	1.16

* From data collected on the Twin Otter and AT-11, respectively.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for Risso's dolphins is 16,818 (CV=0.52). The minimum population estimate for the western North Atlantic Risso's dolphin is 11,140 (CV=0.52).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 11,140 (CV=0.52). The maximum productivity rate is 0.04 , the default value for cetaceans (Barlow *et al*. 1995). The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.48 because the CV of the average mortality estimate is between 0.3-0.6; Wade and Angliss 1997), because this stock is of unknown status. PBR for the western North Atlantic Risso's dolphin is 107.

ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality or serious injury to this stock during 1993-1997 was 7.4 Risso's dolphins (CV = 0.33; Table 2).

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 USA 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 USA 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 USA Atlantic EEZ. In 1982, there were 112 different foreign vessels; 16%, or 18, were Japanese tuna longline vessels operating along the USA east coast. This was the first year that the Northeast Regional Observer Program assumed responsibility for observer coverage of the longline vessels. Between 1983 and 1991, the numbers of foreign vessels operating within USA 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 current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

Pelagic Drift Gillnet

By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet fishery, pelagic pair trawl fishery, and pelagic longline fishery, but no mortalities or serious injuries have been documented in the New England multispecies sink gillnet, mid-Atlantic coastal sink gillnet, or North Atlantic bottom trawl observed fisheries.

The estimated total number of hauls in the pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and 1996 were 233, 243, 232, 197, 164, and 149 respectively. In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Since 1994, between 10 and 12 vessels have participated in the fishery (Table 2). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. 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 pelagic 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 from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 and 1995 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fisheries information. Variances were estimated using bootstrap re-sampling techniques. Forty two Risso's dolphin mortalities were observed between 1989 and 1996. 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), 14 in 1993 (0.42), 1.5 in 1994 (0.16), 6 in 1995 (0), and 0 in 1996. The 1993-1997 average mortality for this fishery was 5.4 (CV = 0.27) (Table 2).

Pelagic Pair Trawl

Effort in the pelagic pair trawl fishery 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 536 hauls in 1992, 586 in 1993, 407 in 1994, and 440 in 1995, respectively. This fishery ceased operations in 1996, when NMFS rejected a petition to consider pair trawl gear as an authorized gear type in Atlantic tunas fishery. The fishery operated from August-November in 1991, from June-November in 1992, from June-October in 1993 (Northridge 1996), and from mid-summer to November in 1994 and 1995. Sea sampling began in October 1992 (Gerrior *et al*. 1994), and 48 sets (9% of the total) were sampled in that season, 102 hauls (17% of the total) were sampled in 1993. In 1994 and 1995, 52% and 55%, respectively, of the sets were observed. 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 1996). One mortality was observed in 1992. Estimated annual fishery-related mortality (CV in parentheses) was 0.6 dolphins in 1991 (1.0), 4.3 in 1992 (0.76), 3.2 in 1993 (1.0), 0 in 1994 and 3.7 in 1995 (0.45). Since this fishery is no longer exists, it has been excluded from Tables 2 and 3.

During the 1994 and 1995 experimental fishing seasons, fishing gear experiments were conducted to collect data on environmental parameters, gear behavior, and gear handling practices to evaluate factors affecting catch and bycatch (Goudey 1995, 1996). Results of these studies were inconclusive in identifying factors responsible for marine mammal bycatch.

Pelagic Longline

Total effort, excluding the Gulf of Mexico, for the pelagic longline fishery, based on mandatory self-reported fisheries information, was11,279 sets in 1991, 9,869 sets in 1992, 9,862 sets in 1993, 9,481 sets in 1994, 10,129 sets in 1995, 9,885 sets in 1996, and 8,023 sets in 1997 (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999). 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. The 1993-1997, estimated take was based on a revised analysis of the observed incidental take and self-reported incidental take and effort data, and replace previous estimates for the 1990-1993 and 1994-1995 periods (Cramer 1994; Scott and Brown 1997; Johnson *et al*. 1999). Most of the estimated marine mammal by-catch was from EEZ waters between South Carolina and Cape Cod. Excluding the Gulf of Mexico, from 1992- 1997 one mortality was observed in 1994 (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999) (Table 2). Estimated annual fishery-related mortality (CV in parentheses) was 0 in 1992 (0), 0 1993 (0), 10 in 1994 (1.0) 0 in 1995-1997. The 1993-1997 estimated mean annual Risso's dolphin mortality attributable to this fishery is 2.0 (CV = 1.0) (Table 2). Injured and released alive animals are not included in the Table 2 mortality estimates. Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

Table 2. Summary of the incidental mortality of Risso's dolphin (*Grampus griseus*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated[5] Mortality	Estimated CVs	Mean Annual Mortality

Pelagic Drift Gillnet	93-97	1994=12[3] 1995=11 1996=10	Obs. Data Logbook	.42, .87, .99, .64, NA	1, 1, 6, 0, NA	14, 1.5 6[4], 0, NA	.42, .16, 0, 0, NA	5.4[6] (.27)
Pelagic Longline[7]	93-97		Obs. Data Logbook	.06, .05, .06, .03, .04	0, 1, 0, 0, 0	0, 10, 0, 0, 0	0, 1.0, 0, 0, 0	2.0 (1.0)
TOTAL								7.4 (0.33)

1 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects weighout (Weighout) landings data, and total landings are used as a measure of total effort for the coastal gillnet fishery and days fished are used as total effort for the North Atlantic bottom trawl fishery. Mandatory logbook (Logbook) data are used to measure total effort for the pelagic drift gillnet fishery, and these data are collected at the Southeast Fisheries Science Center (SEFSC).

2 The observer coverage for the pelagic drift gillnet and pair trawl fishery is measured in terms of sets, and the North Atlantic bottom trawl fishery is in days fished. Assessments for the coastal gillnet fishery have not been completed. The number of trips sampled by the NEFSC Sea Sampling Program are reported here.

3 1994 -1996 shown, other years not available on an annual basis.

4 One vessel was not observed and recorded 1 set in a 10 day trip in the SEFSC mandatory logbook. If you assume the vessel fished 1.4 sets per day as estimated from the 1995 SS data, the point estimate may increase by 0.42 animals. However, the SEFSC mandatory logbook data was taken at face value, and therefore it was assumed that 1 set was fished within this trip, and the point estimate would then increase by 0.03 animals.

5 Injured and released alive animals are not included in the Table 2 mortality estimates.

6 The average is based on the number of years (4; 1993-1996) that the fishery operated.

7 Mortality estimates were taken from Table 12 in Johnson *et al.* (1999), and exclude the Gulf of Mexico.

Table 3. Summary of Risso's dolphin (*Grampus griseus*) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured).

Fishery	Years	Ratio	Injured[2]	Uninjured
Pelagic Longline[3]	93-97	0, 1/10, 0, 0, 0	0, 5 [1] , 2[1], 1, 0	2[4], 1, 2[1], 2, 0

1 See Appendix 1.
2 Injured and released alive animals are not included in the Table 2 mortality estimates.
3 Excludes the Gulf of Mexico.
4 Data from Table 6 (Johnson *et al*. 1999). Information on status of released animals was not reported.

Other mortality

From 1995- 1997, eight Risso's dolphins stranding were recorded along the USA Atlantic coast (NMFS unpublished data).

STATUS OF STOCK

The status of Risso's dolphins relative to OSP in the USA Atlantic EEZ 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. The total fishery mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching a zero mortality and serious injury rate. The 1993-1997 average annual fishery-related mortality does not exceed PBR; therefore, this is not a strategic stock.

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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* sp., 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* sp.) are distributed principally along the continental shelf edge in the winter and early spring off the northeast USA 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 (Waring *et al*. 1992; NMFS unpublished data).

The long-finned pilot whale is distributed from North Carolina to Iceland and possibly the Baltic Sea (Sergeant 1962; Leatherwood *et al*. 1976; Abend 1993). The stock structure of the North Atlantic population is currently unknown (Anon. 1993a); 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 USA and Canadian Atlantic coast is unknown, however, eight estimates are available (Table 1; Figure 1). Two estimates were derived from catch data and population models that estimated the abundance of the entire stock. Six seasonal estimates are available from selected regions in USA waters during spring, summer and autumn 1978-82, August 1990, June-July 1991, August-September 1991, June-July 1993, and July-September 1995. Because long-finned and short-finned pilot whales are difficult to identify at sea, seasonal abundance estimates were reported for *Globicephala* sp., both long-finned and short-finned pilot whales.

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.

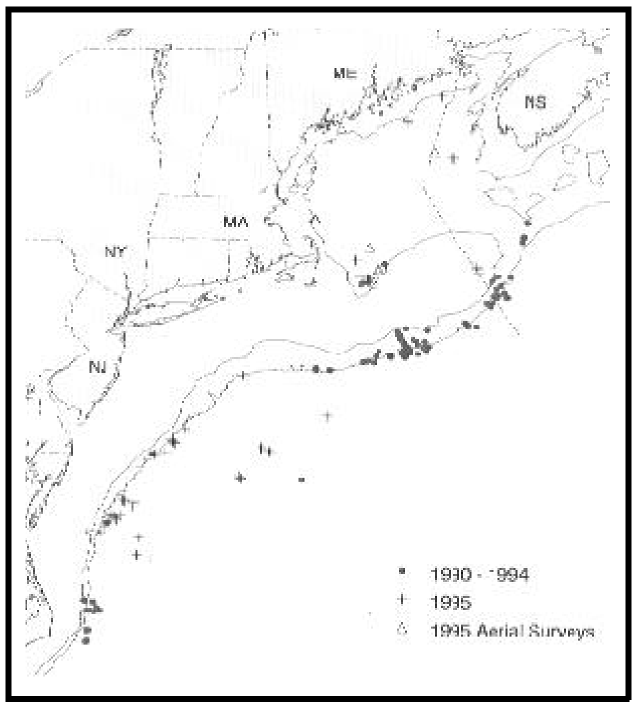

Figure 1. *Distribution of pilot whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

A population size of 11,120 (CV=0.29) *Globicephala* sp. was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). The estimate is based on an inverse variance weighted pooling of spring, summer and autumn data. An average of these seasons were chosen because the greatest proportion of the population off the northeast USA coast appeared in the study area during these seasons. This estimate does not include a correction for dive-time or g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its high degree of uncertainty , its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

A population size of 1,043 (CV=0.78) *Globicephala* sp. was estimated from an August 1990 shipboard line transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (Table 1; Waring *et al.* 1992). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 3,636 (CV = 0.36) *Globicephala* sp. was estimated from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Table 1; Waring *et al.* 1992; Waring 1998). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but no corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 3,668 (CV=0.28) and 5,377 (CV=0.53) *Globicephala* sp. was estimated from line transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11, respectively (Table 1; Anon. 1991). The study area included that covered in the CETAP study plus several additional continental slope survey blocks. 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), where the CV was estimated using the bootstrap option. The abundance estimates do not include g(0) and were not pooled over platforms because the inter-platform calibration analysis has not been conducted.

A population size of 668 (CV=0.55) *Globicephala* sp. was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Table 1; Anon. 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 8,176 (CV=0.65) *Globicephala* sp. was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS unpublished data.). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al.* 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey. An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time. Variability was estimated using bootstrap resampling techniques.

Although the 1990-1995 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 USA coast. The collective 1990-95 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.

The best available current abundance estimate for *Globicephala* sp. is 8,176 (CV=0.65) as estimated from the July to September 1995 line transect survey (NMFS unpublished data.) because this survey is recent and provided the most complete coverage of the known habitat.

Table 1. Summary of abundance estimates for the western North Atlantic *Globicephala* sp. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
1951-1961	Newfoundland	50,000	None reported
1951-1961	Newfoundland	50,000-60,000	None reported
spring, summer & autumn 1978-82	Cape Hatteras, NC to Nova Scotia	11,120	0.29
Aug 1990	Gulf Stream	1,043	0.78
Jun-Jul 1991	Cape Hatteras, NC to Georges Bank, shelf edge only	3,636	0.36
Aug-Sep 1991	Cape Hatteras, NC to Nova Scotia	3,668 and 5,377*	0.28 and 0.53*
Jun-Jul 1993	Georges Bank to Scotian shelf, shelf edge only	668	0.55
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	8,176	0.65

* From data collected on the Twin Otter and AT-11, respectively.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for *Globicephala* sp. is 8,176 (CV=0.65). The minimum population estimate for *Globicephala* sp. is 4,968 (CV=0.65).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include those from animals taken in the Newfoundland drive fishery: 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.

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Globicephala* sp. is 4,968 (CV=0.65). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.45 because the CV of the average mortality estimate is between 0.6-0.8; Wade and Angliss 1997) , and because this stock is of unknown status. PBR for the western North Atlantic *Globicephala* sp. is 45.

ANNUAL HUMAN-CAUSED MORTALITY

Total fishery-related mortality and serious injury cannot be estimated separately for the two species of pilot whales in the USA 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 annual estimated average fishery-related mortality or serious injury to this stock during 1993-1997 was 40.3 pilot whales (CV = 0.71; Table 2).

Fishery Information

USA

Prior to 1977, there was no documentation of marine mammal by-catch in distant-water fleet (DWF) activities off the northeast coast of the USA 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 USA 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 USA 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 USA vessels involved in joint venture fishing operations in which USA 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 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* sp.) are considered together.

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

Pelagic Drift Gillnet

By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet, pelagic longline, and pelagic pair trawl fisheries, but no mortalities or serious injuries have documented in the New England multispecies sink gillnet or mid-Atlantic coastal sink gillnet.

The estimated total number of hauls in the pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and 1996 were 233, 243, 232, 197, 164, and 149 respectively. In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Since 1994, between 10-12 vessels have participated in the fishery (Table 2). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. 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 pelagic drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 and 1995 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fisheries information. Variances were estimated using bootstrap re-sampling techniques. Between 1989 and 1995, sixty -eight mortalities were observed in the large pelagic drift gillnet fishery. The annual fishery-related mortality (CV in parentheses) was 77 in 1989 (0.24), 132 in 1990 (0.24), 30 in 1991 (0.26), 33 in 1992 (0.16), 31 in 1993 (0.19), 20 in 1994 (0.06), 9.1 in 1995 (0), and 11 in 1996 (.17); average annual mortality between 1993-1997 was 17.8 pilot whales (0.09) (Table 2). Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery. 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 Pair Trawl

Effort in the pelagic 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 536 hauls in 1992, 586 in 1993, 407 in 1994, and 440 in 1995, respectively. This fishery ceased operations in 1996, when NMFS rejected a petition to consider pair trawl gear as an authorized gear type in Atlantic tunas fishery. The fishery operated from August-November in 1991, from June-November in 1992, from June-October in 1993, and from mid-summer to November in 1994 and 1995. Sea sampling began in October 1992 (Gerrior *et al*. 1994), and 48 sets (9% of the total) were sampled in that season, 102 hauls (17% of the total) were sampled in 1993. In 1994 and 1995, 52% (212) and 54% (238), respectively, of the sets were observed. Twelve 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 1996). Five pilot whale (*Globicephala* sp.) mortalities were reported in the self-reported fisheries information in 1993. In 1994 and 1995 observers reported one and twelve mortalities, respectively. The estimated fishery-related mortality to pilot whales in the USA Atlantic attributable to this fishery in 1994 was 2.0 (CV=0.49) and 22 (CV=0.33) in 1995. Since this fishery is no longer exists, it has been excluded from Tables 2 and 3.

During the 1994 and 1995 experimental fishing seasons, fishing gear experiments were conducted to collect data on environmental parameters, gear behavior, and gear handling practices to evaluate factors affecting catch and bycatch (Goudey 1995, 1996). Results of these studies were inconclusive in identifying factors responsible for marine mammal bycatch.

Pelagic Longline

The pelagic longline fishery operates in the USA Atlantic (including Caribbean) and Gulf of Mexico EEZ (SEFSC unpublished data). Interactions between the pelagic longline 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 effort, excluding the Gulf of Mexico, for the pelagic longline fishery, based on mandatory self-reported fisheries information, was 11,279 sets in 1991, 9,869 sets in 1992, 9,862 sets in 1993, 9,481 sets in 1994, 10,129 sets in 1995, 9,885 sets in 1996, and 8,023 sets in 1997 (Cramer 1994; Scott and Brown 1997; Johnson *et al*., 1999). Since 1992, this fishery has been monitored with about 5% observer coverage, in terms of trips observed, within every statistical reporting area within the EEZ and beyond. Off the USA Atlantic coast, 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. The 1992-1997, estimated take was based on a revised analysis of the observed incidental take and self-reported incidental take and effort data, and replace previous estimates for the 1992-1993 and 1994-1995 periods (Cramer 1994; Scott and Brown 1997; Johnson *et al*. 1999). Most of the estimated marine mammal by-catch was from EEZ waters between South Carolina and Cape Cod (Johnson *et al*. 1999). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1990-1997 fifty- eight pilot whales (including two identified as a short-fin pilot whale) were released alive, and one mortality was observed. The condition codes that the observers assigned to the disentangled animals were: alive (41 animals); unknown (10 animals); and dead (5 animals). 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. The estimated fishery-related mortality to pilot whales in the USA Atlantic (excluding the Gulf of Mexico) attributable to this fishery was: 40 in 1992 (CV = 1.00), and zero in 1993-1997; average annual mortality between 1993-1997 was 0 pilot whales (Table 2). Injured and released alive animals are not included in the Table 2 mortality estimates. Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

Bluefin Tuna Purse Seine

The tuna purse seine fishery between Cape Hatteras and Cape Cod is directed at small and medium bluefin and skip jack for the canning industry, while north of Cape Cod purse seine vessels are directed at large medium and giant bluefin tuna (NMFS, 1995). The latter fishery is entirely separate from any other Atlantic tuna purse seine fishery. Spotter aircraft are used to locate fish schools. The official start date is August 15, set by regulation. Individual vessel quotas (IVQs) and a limited access system prevent a derby fishery situation. Catch rates are high with this gear and consequently, the season usually only lasts a few weeks for large mediums and giants. The 1996 regulations allocated 250 MT (5 IVQs) with a minimum of 90% giants and 10% large mediums. Limited observer data are available for the bluefin tuna purse seine fishery. Out of 45 total trips made in 1996, 43 trips (95.6%) were observed. Forty-four sets were made on the 43 observed trips and all sets were observed. A total of 136 days were covered. Two interactions with pilot whales were observed in 1996. In one interaction, the net was actually pursed around one pilot whale, the rings were released and the animal escaped alive, condition unknown. This set occurred east of the Great South Channel and just north of the Cultivator Shoals region on Georges Bank. In a second interaction, five pilot whales were encircled in a set. The net was opened prior to pursing to let the whales swim free, apparently uninjured. This set occurred on the Cultivator Shoals region on Georges Bank. This fishery was not observed in 1997.

North Atlantic Bottom Trawl

Vessels in the North Atlantic bottom 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 in 1990, and one animal was released alive and uninjured in 1993. The estimated fishery-related mortality to pilot whales in the USA Atlantic attributable to this fishery was: 0 in 1993-1997; average annual mortality between 1993-1997 was 0 pilot whales (Table 2). However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

Squid, Mackerel, Butterfish Trawl

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 USA 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 was reclassified as a Category II fishery in 1995. In 1996, mackerel, squid, and butterfish trawl fisheries were combined into the Atlantic squid, mackerel, butterfish trawl fishery, and maintained a Category II classification. Three fishery-related mortality of pilot whales were reported in self-reported fisheries information from the mackerel trawl fishery between 1990-1992. One mortality was observed in the 1996 Illex squid fishery. The estimated fishery-related mortality to pilot whales in the USA Atlantic attributable to this fishery was: 45 in 1996 and 0 in 1997; average annual mortality between 1996-1997 was 22.5 pilot whales (CV = 1.27) (Table 2). However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage.

CANADA

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). 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).

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.

Between January 1993 and December 1994, 36 Spanish deep water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets), were observed in NAFO Fishing Area 3 (off the Grand Bank) (Lens 1997). A total of 47 incidental catches were recorded, which included one long-finned pilot whale. The incidental mortality rate for pilot whales was (0.007/set).

Table 2. Summary of the incidental mortality of pilot whales (*Globicephala sp.*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated Mortality [6]	Estimated CVs	Mean Annual Mortality
Pelagic[7] Drift Gillnet	93-97	1994=12[3] 1995=11 1996=10	Obs. Data Logbook	.42, .87, .99, .64, NA	11[4], 17, 9, 7, NA	31, 20, 9.1[5], 11, NA	.19, .06, 0, .17, NA	17.8[7] (0.09)
Atlantic squid, mackerel, butterfish trawl	96-97	NA	Obs. Data Weighouts	.007, .008	6, 0	45, 0	1.27, 0	22.5 (1.27)
N. Atl. Otter Trawl	93-97	NA	Obs. Data Weighouts	.004, .004, .011[8],.002, .002	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0 (0)
Pelagic[9] Longline	93-97		Obs. Data Logbook	.06, .05, .06, .03, .04	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0 (0)
TOTAL								40.3 (0.71)

1 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. Mandatory logbook (Logbook) data are used to measure total effort for the pelagic drift gillnet and longline fishery, and these data are collected at the Southeast Fisheries Science Center (SEFSC).

2 Observer coverage for the pelagic drift gillnet, pair trawl and longline fishery are in terms of sets. The trawl fisheries are measured in trips.

3 1994, 1995 and 1996 shown, other years not available on an annual basis.

4 For 1991-1993, pooled bycatch rates were used to estimate bycatch in months that had fishing effort but did not have observer coverage. This method is described in Northridge (1996). In 1994 and 1995, observer coverage increased substantially, and bycatch rates were not pooled for this period.

5 One vessel was not observed and recorded 1 set in a 10 day trip in the SEFSC mandatory logbook. If you assume the vessel fished 1.4 sets per day as estimated from the 1995 SS data, the point estimate may increase by 0.84 animals. However, the SEFSC mandatory logbook data was taken at face value, and therefore it was assumed that 1 set was fished within this trip, and the point estimate would then increase by 0.06 animals.

6 Annual mortality estimates do not include any animals injured and released alive.

7 The fishery did not operate in 1997; the average annual mortality is based on the number of years (4; 1993-1996) that the fishery operated.

8 Observer coverage for the Atlantic bottom trawl fishery in 1995 is based on only January to May data.

9 Mortality estimates were taken from Table 12 in Johnson *et al*. (1999), and exclude the Gulf of Mexico.

Table 3. Summary of pilot whales (*Globicephala* sp.) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured).

Fishery	Years	Ratio	Injured[3]	Uninjured
Pelagic Drift Gillnet	93-97	11/31, 17/20,9/9.1,7/11, NA	1[1], 0, 0, 0, NA	0
Pelagic Long Line	93-97	0, 0, 0, 0, 0	NA, 5[2], 4[2], 0, 1[2]	16[4], 9[2],10[2], 0, 0
North Atlantic Bottom Trawl	93-97	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 1, 0, 0, 0

1 Released alive with condition unknown.
2 See Appendix 1.
3 Injured and released alive animals are not included in the Table 2 mortality estimates.
4 Data from Table 6 (Johnson *et al*. 1999). Information on status of released animals was not reported.

Other Mortality

Pilot whales 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. 1993b) since 1980. From 1992-1997, 65 long-finned pilot whale stranded between South Carolina and Maine, including 22 animals that mass stranded in 1992 along the Massachusetts coast (NMFS unpublished data).

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 USA Atlantic EEZ 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. 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. The 1993-1997 estimated average annual fishery-related mortality to pilot whales, *Globicephala* sp., did not exceed PBR, therefore, this is not a strategic stock.

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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* sp. 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 USA Atlantic Exclusive Economic Zone (EEZ) is generally thought to be Cape Hatteras, North Carolina (Leatherwood and Reeves 1983). Sightings of these animals in USA 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.

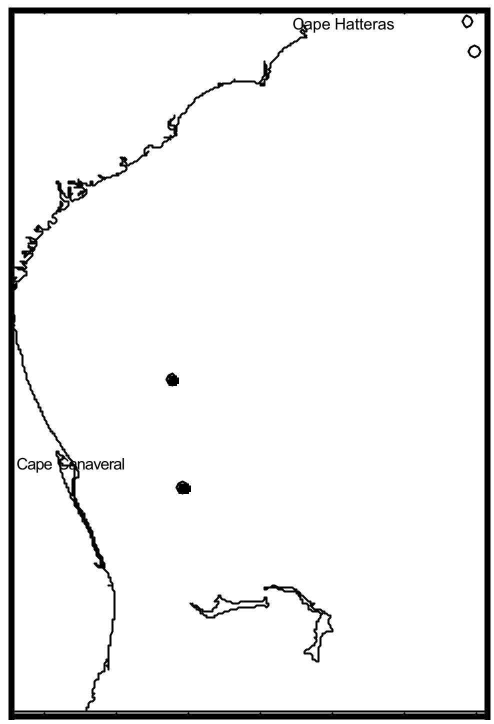

Figure 1. *Sightings of short-finned pilot whales (filled circles) and unidentified pilot whales (unfilled circles) during NOAA Ship Oregon II marine mammal survey cruise in winter 1992.*

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 USA 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-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for short-finned pilot whales is 749 (CV=0.64). The minimum population estimate for the western North Atlantic short-finned pilot whale is 457 (CV=0.64).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 457 (CV=0.64).

The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) was set at 0.45 because of the high variance associated with the estimate of total annual fishery-related mortality and serious injury for *Globicephala* sp. PBR for the western North Atlantic short-finned pilot whales is 4.4.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total fishery-related mortality and serious injury cannot be estimated separately for the two species of pilot whales in the USA 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 annual estimated average fishery-related mortality or serious injury to this stock during 1993-1997 was 40 pilot whales (CV = 0.71; Table 2).

Fishery Information

USA

The level of past or current, direct, human-caused mortality of short-finned pilot whales in the USA Atlantic EEZ is unknown. The short-finned pilot whale has been taken in the pelagic longline fishery in Atlantic waters off the southeastern USA (Lee *et al*. 1994; SEFSC unpublished data).

Prior to 1977, there was no documentation of marine mammal by-catch in distant-water fleet (DWF) activities off the northeast coast of the USA 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 USA 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 USA 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 USA vessels involved in joint venture fishing operations in which USA 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 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* sp.) are considered together.

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

Pelagic Drift Gillnet

By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet, pelagic longline, and pelagic pair trawl fisheries, but no mortalities or serious injuries have documented in the New England multispecies sink gillnet or mid-Atlantic coastal sink gillnet.

The estimated total number of hauls in the pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and 1996 were 233, 243, 232, 197, 164, and 149 respectively. In 1996 and 1997, the NMFS issued management regulations with prohibited the operation of this fishery 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Since 1994, between 10-12 vessels have participated in the fishery (Table 2). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. 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 pelagic drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 and 1995 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fisheries information. Variances were estimated using bootstrap re-sampling techniques. Between 1989 and 1995, sixty -eight mortalities were observed in the large pelagic drift gillnet fishery. The annual fishery-related mortality (CV in parentheses) was 77 in 1989 (0.24), 132 in 1990 (0.24), 30 in 1991 (0.26), 33 in 1992 (0.16), 31 in 1993 (0.19), 20 in 1994 (0.06), 9.1 in 1995 (0), and 11 in 1996 (.17); average annual mortality between 1993-1997 was 17.8 pilot whales (0.09) (Table 2). Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery. 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 Pair Trawl

Effort in the pelagic 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 536 hauls in 1992, 586 in 1993, 407 in 1994, and 440 in 1995, respectively. This fishery ceased operations in 1996, when NMFS rejected a petition to consider pair trawl gear as an authorized gear type in Atlantic tunas fishery. The fishery operated from August-November in 1991, from June-November in 1992, from June-October in 1993, and from mid-summer to November in 1994 and 1995. Sea sampling began in October 1992 (Gerrior *et al*. 1994), and 48 sets (9% of the total) were sampled in that season, 102 hauls (17% of the total) were sampled in 1993. In 1994 and 1995, 52% and 54%, respectively, of the sets were observed. Twelve 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 1996). Five pilot whale (*Globicephala* sp.) mortalities were reported in the self-reported fisheries information in 1993. In 1994 and 1995 observers reported one and twelve mortalities, respectively. Since this fishery no longer exists, it has been excluded from Tables 2 and 3.

During the 1994 and 1995 experimental fishing seasons, fishing gear experiments were conducted to collect data on environmental parameters, gear behavior, and gear handling practices to evaluate factors affecting catch and bycatch (Goudey 1995, 1996). Results of these studies were inconclusive in identifying factors responsible for marine mammal bycatch.

Pelagic Longline

The pelagic longline fishery operates in the USA Atlantic (including Caribbean) and Gulf of Mexico EEZ (SEFSC unpublished data). Interactions between the pelagic longline 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 effort, excluding the Gulf of Mexico, for the pelagic longline fishery, based on mandatory self-reported fisheries information, was 11,279 sets in 1991, 9,869 sets in 1992, 9,862 sets in 1993, 9,481 sets in 1994, 10,129 sets in 1995, 9,885 sets in 1996, and 8,023 sets in 1997 (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999). Since 1992, this fishery has been monitored with about 5% observer coverage, in terms of trips observed, within every statistical reporting area within the EEZ and beyond. Off the USA Atlantic coast, 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. The 1993-1997, estimated take was based on a revised analysis of the observed incidental take and self-reported incidental take and effort data, and replace previous estimates for the 1992-1993 and 1994-1995 periods (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999). Most of the estimated marine mammal by-catch was from EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1990-1997 fifty eight pilot whales (including two identified as a short-fin pilot whale) were released alive, and one mortality was observed. The condition codes that the observers assigned to the disentangled animals were: alive (41 animals); unknown (10 animals); and dead (5 animals). 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. The 1992-1997, estimated take was based on a revised analysis of the observed incidental take and self-reported incidental take and effort data, and replace previous estimates for the 1990-1993 and 1994-1995 periods (Scott and Brown 1997; Johnson *et al.* 1999). The estimated fishery-related mortality to pilot whales in the USA Atlantic (excluding the Gulf of Mexico) attributable to this fishery was: 40 in 1992 (CV = 1.00), and zero in 1993-1997; average annual mortality between 1993-1997 was zero pilot whales (Table 2). Injured and released alive animals are not included in the Table 2 mortality estimates. Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

North Atlantic Bottom Trawl

Vessels in the North Atlantic bottom 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 each was documented in 1990 and 1997, and one animal was released alive and uninjured in 1993. The 1997 mortality occurred within the mid-Atlantic region. The estimated fishery-related mortality to pilot whales in the USA Atlantic attributable to this fishery was: 0 in 1996 and 93 in 1997; average annual mortality between 1996-1997 was 46.5 pilot whales (CV = 0.96) (Table 2). Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

Squid, Mackerel, Butterfish Trawl

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 USA 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 was reclassified as a Category II fishery in 1995. In 1996, mackerel, squid, and butterfish trawl fisheries were combined into the Atlantic squid, mackerel, butterfish trawl fishery, and maintained a Category II classification. Three fishery-related mortality of pilot whales were reported in self-reported fisheries information from the mackerel trawl fishery between 1990-1992. One mortality was observed in the 1996 Illex squid fishery. The estimated fishery-related mortality to pilot whales in the USA Atlantic attributable to this fishery was: 45 in 1996 and 0 in 1997; average annual mortality between 1996-1997 was 22.5 pilot whales (CV = 1.27) (Table 2).

CANADA

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). 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).

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.

Between January 1993 and December 1994, 36 Spanish deep water trawlers, covering 74 fishing trips, were observed in NAFO Fishing Area 3 (off the Grand Bank) (Lens 1997). A total of 47 incidental catches were recorded, which included one long-finned pilot whale. The incidental mortality rate for pilot whales was (0.007/set).

Table 2. Summary of the incidental mortality of pilot whales (Globicephala sp) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated Mortality [6]	Estimated CVs	Mean Annual Mortality
Pelagic[7] Drift Gillnet	93-97	1994=12[3] 1995=11 1996=10	Obs. Data Logbook	.42, .87, .99, .64, NA	11[4], 17, 9, 7, NA	31, 20, 9.1[5], 11, NA	.19, .06, 0, .17, NA	17.8[7] (0.09)
Atlantic squid, mackerel, butterfish trawl	96-97	NA	Obs. Data Weighouts	.007, .008	6, 0	45, 0	1.27, 0	22.5 (1.27)
N. Atl. Otter Trawl	93-97	NA	Obs. Data Weighouts	.004, .004, .011[8],.002, .002	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0 (0)
Pelagic[9] Longline	93-97		Obs. Data Logbook	.06, .05, .06, .03, .04	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0 (0)
TOTAL								40.3 (0.71)

1 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. Mandatory logbook (Logbook) data are used to measure total effort for the pelagic drift gillnet and longline fishery, and these data are collected at the Southeast Fisheries Science Center (SEFSC).

2 Observer coverage for the pelagic drift gillnet, pair trawl and longline fishery are in terms of sets. The trawl fisheries are measured in trips.

3 1994, 1995 and 1996 shown, other years not available on an annual basis.

4 For 1991-1993, pooled bycatch rates were used to estimate bycatch in months that had fishing effort but did not have observer coverage. This method is described in Northridge (1996). In 1994 and 1995, observer coverage increased substantially, and bycatch rates were not pooled for this period.

5 One vessel was not observed and recorded 1 set in a 10 day trip in the SEFSC mandatory logbook. If you assume the vessel fished 1.4 sets per day as estimated from the 1995 SS data, the point estimate may increase by 0.84 animals. However, the SEFSC mandatory logbook data was taken at face value, and therefore it was assumed that 1 set was fished within this trip, and the point estimate would then increase by 0.06 animals.

6 Annual mortality estimates do not include any animals injured and released alive.

7 The fishery did not operate in 1997; the average annual mortality is based on the number of years (4; 1993-1996) that the fishery operated.

8 Observer coverage for the Atlantic bottom trawl fishery in 1995 is based on only January to May data.

9 Mortality estimates were taken from Table 12 in Johnson *et al.* (1999), and exclude the Gulf of Mexico.

Table 3. Summary of pilot whales (*Globicephala* sp) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured).

Fishery	Years	Ratio	Injured[4]	Uninjured
Pelagic Drift Gillnet	93-97	11/31, 17/20,9/9.1,7/11, NA	1[2], 0, 0, 0, NA	0
Pelagic Long Line	93-97	4/38, 0, 0, 0, 0	NA, 5[3], 4[4], 0, 1	NA, 9[3],11[3], 0, 0
North Atlantic Bottom Trawl	93-97	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 1, 0, 0, 0

2 Released alive with condition unknown.

3 See Appendix 1.

4 Injured and released alive animals are not included in the Table 2 mortality estimates.

Other Mortality

There were 193 short-finned pilot whale strandings documented during 1987- 1997along the USA Atlantic coast between Cape Hatteras, North Carolina, and Miami, Florida; five of these were classified as likely caused by fishery interactions. From 1992-1995, eight short-finned pilot whales stranded along beaches north of Cape Hatteras (Virginia to New Jersey) (NMFS unpublished data).

STATUS OF STOCK

The status of the short-finned pilot whale relative to OSP in USA Atlantic EEZ is unknown. There are insufficient data to determine the population trends for this stock. They are not listed under the Endangered Species Act. 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 is a strategic stock because the 1993-1997 estimated average annual fishery-related mortality to pilot whales, *Globicephala* sp., exceeds PBR.

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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 inhabits waters from central west Greenland to North Carolina (about 35• N) and perhaps as far east as 43° W (Evans 1987). Distribution of sightings, strandings and incidental takes suggests the possibly existence of three stocks units: a Gulf of Maine, Gulf of St. Lawrence, and a Labrador Sea stock (Palka *et al.* 1997). No genetic studies have been conducted to test this proposed population structure, although some samples are available to initiate such a study (about 25 specimens). Evidence for a separation between the well documented unit in the southern Gulf of Maine and a Gulf of St. Lawrence population comes from a hiatus of summer sightings along the Atlantic side of Nova Scotia. This has been reported in Gaskin (1992), is evident in Smithsonian stranding records, and was seen during an abundance survey conducted in summer 1995 that covered waters from Virginia to the entrance of the Gulf of St. Lawrence. White-sided dolphins were seen frequently in eastern Gulf of Maine waters and in waters at the mouth of the Gulf of St. Lawrence, but only one sighting was recorded in the waters between these two regions.

The Gulf of Maine stock of white-sided dolphins are most common in continental shelf waters from Hudson Canyon (approximately 39• N) north through Georges Bank, and in the Gulf of Maine to the lower Bay of Fundy. Sightings data indicate seasonal shifts in distribution. During January to April, low numbers of white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire), and even lower numbers are south of Georges Bank, as documented by a few strandings collected on beaches of Virginia and North Carolina. From June through September, large numbers of white-sided dolphins are found from Georges Bank to lower Bay of Fundy. From October to December, white-sided dolphins occur at intermediate densities from southern Georges Bank to southern Gulf of Maine (Payne and Heinemann 1990). Sightings south of Georges Bank and around Hudson Canyon have been seen at all times of the year but at low densities. The Virginia and North Carolina observations appear to represent the southern extent of the species range.

Prior to the 1970's, white-sided dolphins in USA waters were found primarily offshore on the continental slope, while white-beaked dolphins (*L. albirostris*) were found on the continental shelf. During the 1970's, there was an apparent switch in habitat use between these two species. This shift may of been a result of the increase in sand lance in the continental shelf waters (Katona *et al.* 1993; Kenney *et al.* 1996).

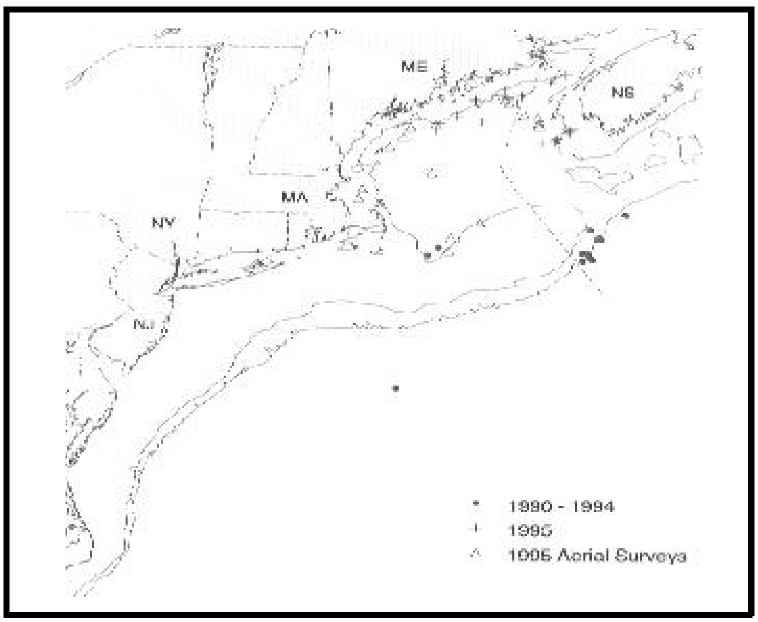

Figure 1. *Distribution of white-sided dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

The total number of white-sided dolphins along the eastern USA and Canadian Atlantic coast is unknown, although four estimates from select regions are available from spring, summer and autumn 1978-82, July-September 1991-92, and July-September 1995 (Table 1; Figure 1).

A population size of 28,600 white-sided dolphins (CV=0.21) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). The estimate was based on an inverse variance weighted pooling of spring, summer and autumn data. An average of these seasons were chosen because the greatest proportion of the population off the northeast USA coast appeared in the study area during these seasons. This estimate does not include a correction for dive-time or g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

A population size of 20,400 (CV=0.63) white-sided dolphins was estimated from two shipboard line transect surveys conducted during July to September 1991 and 1992 in the northern Gulf of Maine-lower Bay of Fundy region (Table 1; Palka *et al*. 1997). This population size is a weighted-average of the 1991 and 1992 estimates, where each annual estimate was weighted by the inverse of its variance. The data were collected during surveys designed to estimate abundance of harbor porpoises (Palka 1995). Two independent teams of observers on the same ship surveyed using naked eye in non-closing mode. Using the product integral analytical method (Palka 1995) and DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993) the abundance included an estimate of school size-bias, if applicable, an estimate of g(0), probability of detecting a group on the track line, but no correction for dive-time or ship avoidance. Variability was estimated using bootstrap re-sampling.

A population size of 729 (CV = 0.47) white-sided dolphins was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Table 1; Anon. 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0), dive-time or ship avoidance. Variability was estimated using bootstrap re-sampling techniques.

A population size of 27,200 (CV=0.43) white-sided dolphins was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS/NEFSC unpublished data). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al*. 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey (Palka 1996). An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time or ship avoidance. Variability was estimated using bootstrap re-sampling techniques.

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

The best available current abundance estimate for white-sided dolphins in USA waters is 27,200 (CV=0.43) as estimated from the July to September 1995 line transect survey because this survey is recent and provided the most complete coverage of the known habitat.

Table 1. Summary of abundance estimates for western North Atlantic white-sided dolphins. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
spring, summer & autumn 1978-82	Cape Hatteras, NC to Nova Scotia	28,600	0.21
Jul-Sep 1991-92	N. Gulf of Maine and Bay of Fundy	20,400	0.63
Jun-Jul 1993	Georges Bank to Scotian shelf, shelf edge only	729	0.47
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	27,200	0.43

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for white-sided dolphins is 27,200 (CV=0.43). The minimum population estimate for the western North Atlantic white-sided dolphins is 19,196 (CV=0.43).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: 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; mean adult length is 250 cm for males and 224 cm for females (Evans 1987); and maximum reported age for males is 22 years and for females, 27 years (Sergeant *et al.* 1980).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 19,196 (CV=0.43). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.48 because this stock is of unknown status and the CV of the mortality estimate is between 0.3 and 0.6. PBR for the western North Atlantic white-sided dolphin is 184.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Recently, within USA waters, white-sided dolphins have been caught in the New England multispecies sink gillnet, Mid-Atlantic coastal gillnet, pelagic drift gillnet, North Atlantic bottom trawl, and Atlantic squid, mackerel, butterfish trawl fisheries (Table 2). Estimated average annual fishery-related mortality and serious injury to the western North Atlantic white-sided dolphin stock from these USA fisheries during 1993-1997 was 287 dolphins per year (CV = 0.47).

Earlier Interactions

In the past, incidental takes of white-sided dolphins have been recorded in the New England and Bay of Fundy multispecies gillnet fisheries and the Atlantic foreign mackerel fishery. In the mid 1980's, during a University of Maine study, gillnet fishermen reported six takes of white-sided dolphins of which two carcasses were necropsied for biological studies (Gilbert and Wynne 1987; Gaskin 1992). 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 USA vessels involved in joint-venture fishing operations in which USA captains transfer their catches to foreign processing vessels. Prior to 1977, there was no documentation of marine mammal by-catch in distant-water fleet (DWF) activities off the northeast coast of the USA 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 USA 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 USA east coast. This was the first year that the Northeast Regional Observer Program assumed responsibility for observer coverage of the longline vessels. Between 1983 and 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.

USA

New England Multispecies Sink Gillnet

Between 1990 and 1997 there were 39 mortalities observed in the New England multispecies sink gillnet fishery (Table 2). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year this fishery has been covered by the program. In 1993 there were approximately 349 vessels (full and part time) in the New England multispecies sink gillnet fishery (Walden 1996). Observer coverage, expressed as a percentage of the number of trips, has been 1%, 6%, 7%, 5%, 7%, 5%, 4%, and 6% for years 1990 to 1997, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. Most white-sided dolphins have been taken in waters south of Cape Ann during April to December. In recent years, the majority are east and south of Cape Cod. Estimated annual fishery-related mortalities (CV in parentheses) were 49 in 1991 (0.46), 154 in 1992 (0.35), 205 in 1993 (0.31), 240 in 1994 (0.51), 80 in 1995 (1.16), 114 in 1996 (0.61) (Bisack 1997a), and 140 (0.61) in 1997. Average annual estimated fishery-related mortality during 1993-1997 was 156 white-sided dolphins per year (0.26) (Table 2).

Mid-Atlantic Coastal Gillnet

One white-sided dolphin was observed taken in this fishery during 1997 (Table 2). None were taken in observed trips during 1993 to 1996. In July 1993, an observer program was initiated in the USA Atlantic coastal gillnet fishery by the NEFSC Sea Sampling program. Twenty trips were observed during 1993. During 1994 and 1995 221 and 382 trips were observed, respectively. This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, 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. Observer coverage, expressed as percent of tons of fish landed, was 5%, 4%, and 3% for 1995, 1996, and 1997, respectively (Table 2). During 1995 and 1996, observed fishing effort was concentrated off NJ and scattered between DE and NC from 1 to 50 miles off the beach. By-catch estimates were determined using methods similar to that used for by-catch estimates in the New England multispecies gillnet fishery (Bravington and Bisack 1996; Bisack 1997a). Using the observed takes of white-sided dolphins, the estimated annual mortality (CV in parentheses) attributed to this fishery was 0 for 1995 and 1996, and 45 (0.82) for 1997. However, because the spatial-temporal distribution of observer coverage did not cover all types of gillnet fisheries in the mid-Atlantic region during all times of the year, it is likely that the estimated numbers are under-estimates. Average estimated white-sided dolphin mortality and serious injury from the Mid-Atlantic coastal gillnet fishery during 1995 to 1997 was 15 (CV=0.82) (Table 2).

Pelagic Drift Gillnet

In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnet gear in the North Atlantic swordfish fishery (50 CFR Part 630). During 1991 to 1996, two white-sided dolphins were observed taken in the Atlantic pelagic drift gillnet fishery. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The estimated total number of hauls in the Atlantic pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995 and 1996 were 233, 243, 232, 197, 164, and 149 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994, 1995, and 1996 there were 11, 12, and 10 vessels, respectively, in the fishery (Table 2). Observer coverage, expressed as percent of sets observed was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. Observer coverage dropped during 1996 because some vessels were deemed too small or unsafe by the contractor that provided observer coverage to NMFS. Fishing effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras. Examination of the species composition of the catch and locations of the fishery throughout the year, suggested that the drift gillnet fishery is stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, for each year from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 through 1996 were estimated for each year separately by summing the observed caught with the product of the average by-catch per haul and the number of unobserved hauls as recorded in logbooks. Variances were estimated using bootstrap re-sampling techniques (Bisack 1997b). Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 4.4 in 1989 (.71), 6.8 in 1990 (.71), 0.9 in 1991 (.71), 0.8 in 1992 (.71), 2.7 in 1993 (0.17), 0 in 1994, 1995, and 1996. There was no fishery during 1997. Estimated average annual mortality and serious injury related to this fishery during 1993-1996 was 0.7 white-sided dolphins (0.17) (Table 2).

North Atlantic Bottom Trawl

Three mortalities were documented between 1991 and 1997 in the North Atlantic bottom trawl fishery (Table 2). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year this fishery has been covered by the program, though at a low level. Vessels in the North Atlantic bottom 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 one white-sided dolphin taken in 1992 was taken in a haul that was composed of 43% cod, 20% silver hake, and 17% pollock. One of the 1994 takes was in a haul that was composed of 42% white hake, 19% pollock, and 16% monkfish. The other 1994 take was in a haul that kept seven species of which none were dominant. The estimated fishery-related mortality from 1992 was 110 (CV = 0.97), from 1994 it was 182 (CV=0.71), and it was 0 in the other years (Bisack 1997b). The average annual estimate fishery-related mortality during 1993-1997 was 36.4 white-sided dolphins (CV = 0.71) (Table 2).

Squid, Mackerel, Butterfish Trawl

One white-sided dolphin was observed taken in the mackerel sub-fishery during 1997 (Table 2). The squid, mackerel, butterfish trawl fishery, though managed under one FMP by the Mid-Atlantic Fisheries Management Council, is actually three independent fisheries operating in different areas during different times of the year (NMFS 1998). The Loligo squid sub-fishery is mostly in southern New England, New York and Mid-Atlantic waters, where fishing patterns reflect the seasonal migration of the Loligo (offshore during October to March and inshore during April to September). The Illex sub-fishery is primarily on the continental slope during June to September. The mackerel sub-fishery during January to May is primarily in the southern New England and Mid-Atlantic waters, while during May to December, it is primarily in the Gulf of Maine. The butterfish sub-fishery is primarily a by-catch of the squid and mackerel sub-fisheries. Butterfish migrate north and inshore during the summer, and south and offshore during the winter. In 1995, the squid, mackerel, butterfish trawl fishery was classified as a Category II fishery. Observer coverage was very low; as expressed as percentage of trips observed, it was 0.07% in 1996 and 0.08% in 1997. The by-catch, stratified by sub-fishery, season and geographical area, was estimated using the ratio estimator method, as was documented in Bisack (1997b). The estimated fishery-related mortality was 0 in 1996 and 161 (CV=1.58) in 1997. The average annual estimated fishery-related mortality during 1996 and 1997 was 80.5 (CV=1.58) (Table 2).

CANADA

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 gillnet sets in the Bay of Fundy during 1985 to 1989, and nine were taken in West Greenland between 1964 and 1966 in the now non-operational salmon drift nets (Gaskin 1992). Several (number not specified) were also taken during the 1960's in the now non-operational Newfoundland and Labrador groundfish gillnets. 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.

Table 2. Summary of the incidental mortality of white-sided dolphins (*Lagenorhynchus acutus*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
New England Multispecies Sink Gillnet	93-97	1993=349	Obs. Data Weighout Trip Logbook	.05, .07, .05, .04,.06	7, 10[3], 2[3], 2[3],4[3]	205, 240[3], 80[3], 114[3],140[3]	.31, .51, 1.16, .61,.61	156.0 (.0.26)
Mid-Atlantic Coastal Sink Gillnet	95-97	Unk[8]	Obs. Data Weighout	.05, .04, .03	0, 0, 1	0, 0, 45	0 , 0 ,.82	15 (0.82)
Pelagic Drift Gillnet	93-97[7]	1994=11[4] 1995=12 1996=10 1997=NA[7]	Obs. Data Logbook	.42, .87, .99,.64, NA[7]	2[5],0[5], 0[5], 0[5], NA[7]	2.7[5], 0[5], 0[5], 0[5], NA[7]	0.17, 0, 0, 0, NA[7]	0.7[7] (0.17)
North Atlantic Bottom Trawl	93-97	1993=970	Obs. Data Weighout	.004, .004,.011[6], ,.002, .002	0, 2, 0, 0, 0	0, 182, 0, 0, 0	0, .71, 0, 0, 0	36.4 (0.71)
Squid, Mackerel, Butterfish Trawl	96-97	Unk[8]	Obs. Data Weighout	.007, .008	0, 1[9]	0, 161[9]	0, 1.58[9]	80.5 (1.58)
Total								287 (0.47)

1 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects Weighout (Weighout) landings data which is used as a measure of total effort. Mandatory trip logbook (Trip Logbook) data are used to determine the spatial distribution of some fishing effort in the sink gillnet fishery. Mandatory logbook (Logbook) data are used to measure total effort for the pelagic drift gillnet fishery, and these data are collected at the Southeast Fisheries Science Center (SEFSC).

2 Observer coverage for the New England sink gillnet and Atlantic bottom trawl fisheries are measured in trips, the pelagic drift gillnet fishery is measured in sets, and the Mid-Atlantic coastal sink gillnet fishery is measured in tons of fish landed.

3 White-sided dolphins taken on observed pinger trips were added directly to the estimated total by-catch for that year when there was no closure in effect. There was one observed white-sided dolphin take on a pinger trip in 1994, which was not included in the observed mortality count, no takes observed in pinger trips during 1995 and 1996, and two takes, not included in the observed mortality count, were observed in pingered trips during 1997.

4 1994 to 1997 shown, other years not available on an annual basis.

5 For 1991-1993, pooled bycatch rates were used to estimate bycatch in months that had fishing effort but did not have observer coverage (Northridge 1996). After 1993, observer coverage increased substantially, and by-catch rates were annual rates (Bisack 1997b). There was no fishery in 1997.

6 Observer coverage for the Atlantic bottom trawl fishery in 1995 is based on only January to May data (the only time takes were observed).

7 Fishery closed during 1997. So average by-catch is from 1993 to 1996.

8 Number of vessels is not known.

9 The observed take was in the mackerel sub-fishery.

Other Mortality

Mass strandings involving up to a hundred or more animals at one time are common for this species. From 1968 to 1995, 349 Atlantic white-sided dolphins were known to have stranded on the New England coast (Hain and Waring 1994; Smithsonian stranding records 1996). 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.

From the NE Regional Office/NMFS strandings and entanglement database, there were 17 recorded stranded white-sided dolphins during 1997, of which 16 died and one was released alive (from RI during Feb). One stranding was in VA during March, the rest were from MD to ME during January to August, where 10 were from MA. The cause of death of these strandings were not determined.

STATUS OF STOCK

The status of white-sided dolphins, relative to OSP, in the USA Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this species. 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 is a strategic stock because estimated average annual fishery-related mortality and serious injury exceeds PBR.

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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, pers. comm.).

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 USA 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; Gowans and Whitehead 1995).

POPULATION SIZE

The total number of common dolphins off the eastern USA and Canadian Atlantic coast is unknown, although four estimates are available from selected regions during June-July 1991, June-July 1993, and July-September 1995 (Table 1; Figure 1).

A population size of 29,610 (CV = 0.39) common dolphins was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). R. Kenney (pers. comm.) provided abundance estimates that accounted for survey effort in two continental slope survey blocks and uncertainties resulting from sightings of unidentified small dolphins. The estimate is based on an inverse variance weighted pooling of spring and summer data. An average of these seasons were chosen because the greatest proportion of the population off the northeast USA coast appeared in the study area during these seasons. This estimate does not include a correction for dive-time or g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its high degree of uncertainty, its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

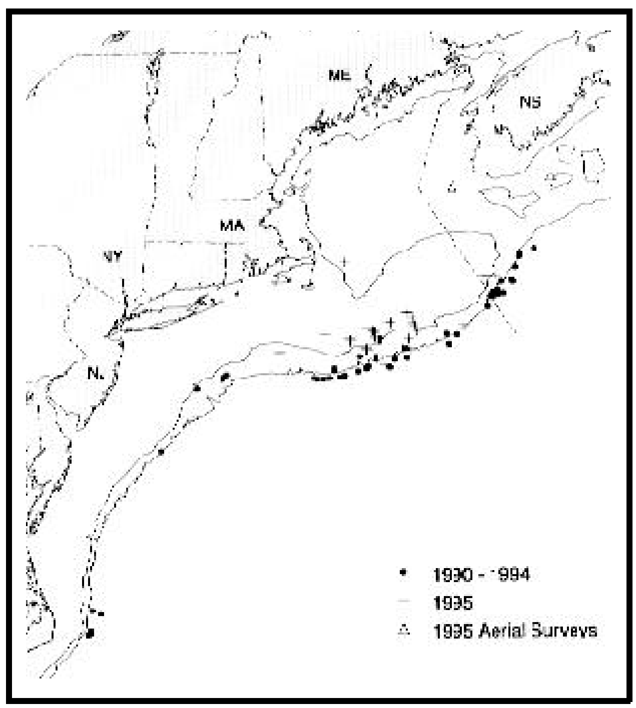

Figure 1. *Distribution of common dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

A population size of 22,215 (CV=0.40) common dolphins was estimated from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Table 1; Waring *et al*. 1992; Waring 1998). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but no corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 1,645 (CV=0.47) common dolphins was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Table 1; Anon. 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al*. 1993; Laake *et al*. 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 6,741(CV=0.69) common dolphins was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS, unpublished data). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. However, the August 1995 ship survey on Georges Bank was greatly hindered by hurricane events. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al*. 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey. An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time. Variability was estimated using bootstrap resampling techniques.

Although the 1991, 1993, and 1995 surveys did not sample the same areas or encompass the entire common dolphin habitat (e. g., little effort in Scotian shelf edge waters), they did focus on segments of known or suspected high-use habitats off the northeastern USA coast. The 1991, 1993, and 1995 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.

The best available current abundance estimate for common dolphins is 22,215 (CV=0.40) as estimated from the June to July 1991 line transect survey because this survey provided the most complete coverage of the known habitat, particularly Georges Bank which was inadequately surveyed in 1995 (see above).

Table 1. Summary of abundance estimates for western North Atlantic common dolphin. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
spring & summer 1978-82	Cape Hatteras, NC to Nova Scotia	29,610	0.39
Jun-Jul 1991	Cape Hatteras, NC to Georges Bank, shelf edge only	22,215	0.40
Jun-Jul 1993	Georges Bank to Scotian shelf, shelf edge only	1,645	0.47
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	6,741	0.69

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for common dolphins is 22,215 (CV=0.40). The minimum population estimate for the western North Atlantic common dolphin is 16,060 (CV=0.40).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 16,060 (CV=0.40). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.48 because the CV of the average mortality estimate is between 0.3-0.6; Wade and Angliss 1997) , and because this stock is of unknown status. PBR for the western North Atlantic common dolphin is 154.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 1993-1997 was 780 common dolphins CV = 0.45; Table 2).

Fishery Information

USA

Prior to 1977, there was no documentation of marine mammal by-catch in distant-water fleet (DWF) activities off the northeast coast of the USA 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 USA east coast. This was the first year that the Northeast Regional Observer Program assumed responsibility for observer coverage of the longline vessels. Between 1983 and 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.

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 USA vessel involved in joint-venture fishing operations in which USA captains transfer their catches to foreign processing vessels. The by-catch occurred during winter/spring (December to May).

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet, pelagic pair trawl, pelagic longline fishery, mid-Atlantic coastal sink gillnet, North Atlantic bottom trawl, New England multispecies sink gillnet, and Atlantic squid, mackerel, butterfish trawl fisheries.

Pelagic Drift Gillnet

The estimated total number of hauls in the pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and

1996 were 233, 243, 232, 197, 164, and 149 respectively. In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Since 1994, between 10-12 vessels have participated in the fishery (Table 2). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. 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 pelagic drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 and 1995 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fisheries information. Variances were estimated using bootstrap re-sampling techniques. Six hundred and six common dolphin mortalities were observed between 1989 and 1996 in this fishery. Mortalities were observed in all seasons and areas. Seven animals were released alive, but six were injured. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 540 in 1989 (0.19), 893 in 1990 (0.18), 223 in 1991 (0.12), 227 in 1992 (0.09), 238 in 1993 (0.08), 163 in 1994 (0.02), 83 in 1995 (0), and 106 in 1996 (0.07); average annual estimated fishery-related mortality during 1993-1997 attributable to this fishery was 148 common dolphins (CV = 0.04) (Table 2). Injured and released alive animals are not included in the Table 2 mortality estimates. Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

Pelagic Pair Trawl

During the period 1989 to 1993, effort in the pelagic pair trawl fishery increased from zero hauls in 1989 and 1990, to an estimated 171 hauls in 1991 and then to an estimated 536 hauls in 1992 and 586 in 1993, 407 in 1994 and 440 in 1995. This fishery ceased operations in 1996, when NMFS rejected a petition to consider pair trawl gear as an authorized gear type in Atlantic tunas fishery. The fishery operated from August to November in 1991, from June to November in 1992, from June to October in 1993 (Northridge 1996), and from mid-summer to December in 1994 & 1995. Sea sampling began in October of 1992 (Gerrior *et al*. 1994) where 48 sets (9% of the total) were sampled. In 1993, 102 hauls (17% of the total) were sampled. In 1994 and 1995, 52% (212) and 55% (238), respectively, of the sets were observed. 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 from 1991 to 1993. Examination of the (1991-1993) 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. Twelve mortalities were observed between 1991 and 1995. 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), 35 in 1993 (0.43), 0 in 1994 (0), and 5.6 in 1995 (0.35). Since this fishery is no longer in operation it has been deleted from Tables 2 and 3.

During the 1994 and 1995 experimental pelagic pair trawl fishing seasons, fishing gear experiments were conducted to collect data on environmental parameters, gear behavior, and gear handling practices to evaluate factors affecting catch and bycatch (Goudey 1995, 1996). Results of these studies have been presented at Offshore Cetacean Take Reduction Team Meetings.

Pelagic Longline

The pelagic longline fishery operates in the USA Atlantic (including Caribbean) and Gulf of Mexico EEZ (SEFSC unpublished data). Interactions between the pelagic longline 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 effort, excluding the Gulf of Mexico, for the pelagic longline fishery, based on mandatory self-reported fisheries information, was11,279 sets in 1991, 9,869 sets in 1992, 9,862 sets in 1993, 9,481 sets in 1994, 10,129 sets in 1995, 9,885 sets in 1996, and 8,023 sets in 1997 (Cramer 1994; Scott and Brown 1997; Johnson *et al*. 1999). Since 1992, this fishery has been monitored with about 5% observer coverage, in terms of trips observed, within every statistical reporting area within the EEZ and beyond. Off the USA Atlantic coast, 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. The 1993-1997, estimated take was based on a revised analysis of the observed incidental take and self-reported incidental take and effort data, and replace previous estimates for the 1992-1993 and 1994-1995 periods (Cramer 1994; Scott and Brown 1997; Johnson *et al*. 1999). Most of the estimated marine mammal by-catch was from EEZ waters between South Carolina and Cape Cod (Johnson *et al*. 1999). Between 1990-1997 one common dolphin was hooked and released alive.

New England Multispecies Sink Gillnet

In 1993, there were approximately 349 full and part-time vessels in the New England multispecies sink gillnet fishery, which covered the Gulf of Maine and southern New England (Table 2). 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 1996) and their fishing effort was not used in estimating mortality. Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%, 4%, and 6% for 1990 to 1997, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. In 1996, the first observed mortality of common dolphins in this fishery was recorded. The estimated mortality was 63 common dolphins (CV = 1.39); estimated annual mortality (1993-1997) was 12.6 common dolphins (CV = 1.39) (Table 2). Annual estimates of common dolphin by-catch in the New England multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort.

Mid-Atlantic Coastal Gillnet

Observer coverage of the USA 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. During 1994 and 1995 221 and 382 trips were observed, respectively. This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, 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. Observer coverage, expressed as percent of tons of fish landed, was 5% 4%, and 3% for 1995, 1996, and 1997 (Table 2).

No common dolphins were taken in observed trips during 1993 and 1994. Two common dolphin were observed taken in 1995 and 1996 , and no takes were observed in 1997 (Table 2). Observed effort was concentrated off NJ and scattered between DE and NC from 1 to 50 miles off the beach. All by-catches were documented during January to April. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 7.4 in 1995 (CV = 0.69), 43 in 1996 (0.79), and 16 in 1997 (0.53). Average annual estimated fishery-related mortality attributable to this fishery during 1995-1997 was 22 common dolphins (CV = 0.53)

North Atlantic Bottom Trawl

Vessels in the North Atlantic bottom trawl fishery, a Category III fishery under MMPA, were observed in order to meet fishery management needs, rather than marine mammal management needs. An average of 970 vessels (full and part time) participated annually in the fishery during 1991-1995. The fishery is active in all seasons in New England waters. Four mortalities were observed between 1991-1997. The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 0 in 1991, 0 in 1992, 0 in 1993, 0 in 1994 (0), 142 in 1995 (0.77), 0 in 1996 (0), and 93 in 1997 (1.06). Average annual estimated fishery-related mortality attributable to this fishery during 1993-1997 was 47 common dolphins (CV = 0.63) (Table 2). However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage.

Squid, Mackerel, Butterfish Trawl

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 USA 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 was reclassified as a Category II fishery in 1995. In 1996, mackerel, squid, and butterfish trawl fisheries were combined into the Atlantic squid, mackerel, and butterfish trawl fishery, and maintained a Category II classification. Three common dolphin mortalities were observed in 1996 and one in 1997 (Table 2). The 1996 mortalities were in the Loligo squid fishery and the 1997 mortality occurred in the Atlantic mackerel fishery. The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 940 in 1996 (0.75), and 161 in 1997 (0.49). Average annual estimated fishery-related mortality attributable to this fishery during 1996-1997 was 551 common dolphins (CV = 0.64) (Table 2). However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage and uncertainties regarding number of vessels participating in this "fishery".

CANADA

Between January 1993 and December 1994, 36 Spanish deep water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets), were observed in NAFO Fishing Area 3 (off the Grand Bank) (Lens 1997). A total of 47 incidental catches were recorded, which included one common dolphin. The incidental mortality rate for common dolphins was (0.007/set).

Table 2. Summary of the incidental mortality of common dolphins (*Delphinus delphis*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated[6] Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Drift Gillnet[8]	93-97	1994=11 1995=12 1996=10[3]	Obs. Data Logbook	.42, .87, .99, .64, NA	113, 142, 82, 74, NA	227, 238, 163, 83[4],106, NA	.09, .08, .02, 0, .07, NA	147.5[8] (.04) (.04)
New England Multispecies Sink Gillnet	93-97	349	Obs. Data Weighout, Logbooks	.05, .07, .05, .04, .06	0, 0, 0, 1, 0	0, 0, 0, 63, 0	0, 0, 0, 1.39, 0	12.6 (1.39)
Mid-Atlantic Coastal Sink Gillnet	95-97	NA	Obs. Data Weighout	.05, .04, .03	2, 2, 2	7.4, 43, 16	.69, .79, .53	22.0 (.53)
Atlantic squid, mackerel, butterfish trawl	96-97	NA	Obs. Data Weighout	.007, .008	3, 1	940, 161	.75, .49	551 (.64)
North Atlantic Bottom Trawl	93-97	970	Obs. Data Weighout	.004, .004, .011[5], .002, .002	0, 0, 3, 0, 1	0, 0, 142, 0, 93	0, 0, .77, 0, 1.06	47 (.63)
TOTAL								780 (.45)

1 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects weighout (Weighout) landings data, and total landings are used as a measure of total effort for the coastal gillnet fishery and days fished are used as total effort for the North Atlantic bottom trawl fishery. Mandatory logbook (Logbook) data are used to measure total effort for the pelagic drift gillnet fishery, and these data are collected at the Southeast Fisheries Science Center (SEFSC).

2 The observer coverage for the pelagic drift gillnet and pair trawl fishery is measured in terms of sets, and the North Atlantic bottom trawl fishery is in trips. Assessments for the coastal gillnet fishery have not been completed. The number of trips sampled by the NEFSC Sea Sampling Program are reported here.

3 1994 - 1996 shown, other years not available on an annual basis.

4 One vessel was not observed and recorded 1 set in a 10 day trip in the SEFSC mandatory logbook. If you assume the vessel fished 1.4 sets per day as estimated from the 1995 SS data, the point estimate may increase by 7.0 animals. However, the SEFSC mandatory logbook data was taken at face value, and therefore it was assumed that 1 set was fished within this trip, and the point estimate would then increase by 0.50 animals.

5 Observer coverage for the North Atlantic bottom trawl fishery in 1995 is based on January to May data.

6 Injured and released alive animals are not included in the Table 2 mortality estimates.

8 The fishery did not operate in 1997; the average annual mortality is based on the number of years (4; 1993-1996) that the fishery operated.

Table 3. Summary of common dolphins (Delphinus delphis) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured)

Fishery	Years	Ratio	Injured[4]	Uninjured
Pelagic Drift Gillnet	93-97	113/238, 142/163, 82/83, 74/106, NA	3[1], 1[2], 0, 3[3], NA	0, 0, 0, 0, NA

[1] Released alive, 2 were moderately injured and 1 common dolphin was severely injured.
[2] Released alive and gear was "in/around several body parts".
[3] Released alive, one animal "seemed tired," but had few wounds, little bleeding from fluke. Both animals were smaller as compared to other common dolphins taken in the same set.
[4] Injured and released alive animals are not included in the Table 2 mortality estimates.

Other Mortality

From 1992-1997, 69 common dolphins were stranded between North Carolina and Massachusetts, predominantly along beaches in the latter state (NMFS unpublished data). The total includes ten common dolphins that mass stranded in November 1997 on Cape Cod.

STATUS OF STOCK

The status of common dolphins, relative to OSP, in the USA Atlantic EEZ 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. 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 is a strategic stock because the 1993-1997 average annual fishery-related mortality and serious injury exceeds PBR.

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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 USA 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 Atlantic spotted dolphins off the eastern USA coast is unknown. However, two population sizes are available for select regions from spring and summer 1978-82 and July-September 1995 (Table 1; Figure 1). Because *S. frontalis* and *S. attenuata* are difficult to differentiate at sea, the reported abundance estimates are for both species of spotted dolphins.

A population size of 6,107 (CV=0.27) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). R. Kenney (pers. comm.) 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. The estimate is based on an inverse variance weighted pooling of spring and summer data. An average of these seasons were chosen because the greatest proportion of the population off the northeast USA coast appeared in the study area during these seasons. This estimate does not include a correction for dive-time or g(0), the probability of detecting an animal group on the track line. Furthermore, this survey did not cover important spotted dolphin habitat in the continental shelf between Cape Hatteras and Florida, and Atlantic deep oceanic waters. This estimate may not reflect the current true population size because of its high degree of uncertainty , its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

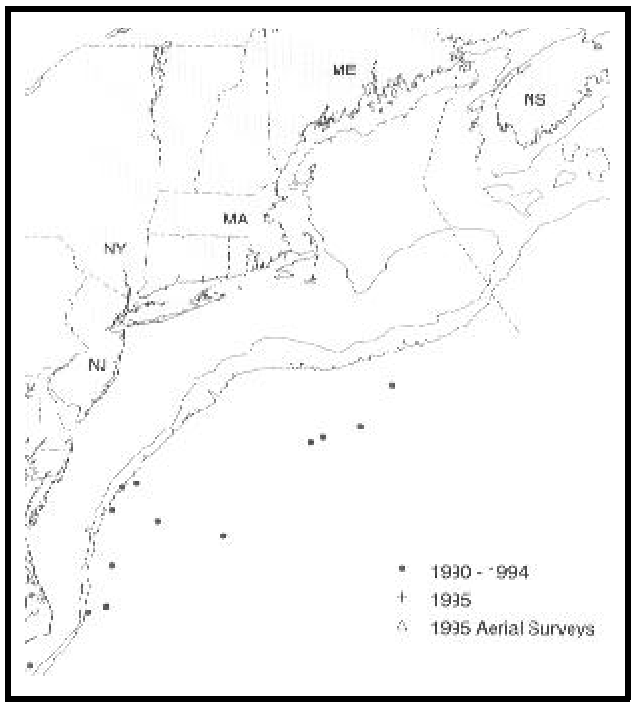

Figure 1. *Distribution of spotted dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

A population size of undifferentiated 4,772 (CV=1.27) spotted dolphins was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS, unpublished data). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al.* 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey. An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time. Variability was estimated using bootstrap resampling techniques.

The best available current abundance estimate for the undifferentiated group of spotted dolphins is 4,772 (CV=1.27) as estimated from the July to September 1995 line transect survey (NMFS, unpublished data) because this survey is recent and provided the most complete coverage of the known habitat.

Table 1. Summary of abundance estimates for a combination of the Atlantic and pantropical spotted dolphin. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
spring & summer 1978-82	Cape Hatteras, NC to Nova Scotia	6,107	0.27
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	4,772	1.27

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the undifferentiated group of spotted dolphins is 4,772 (CV=1.27). The minimum population estimate for the undifferentiated group of spotted dolphins is 1,617 (CV=1.27).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the undifferentiated group of spotted dolphins is 1,617 (CV=1.27). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is set to 0.5 because this stock is of unknown status. PBR for the undifferentiated group of spotted dolphins combined is 16. However, it is not reasonable to calculate a PBR for the Atlantic spotted dolphin alone, because it was impossible to separately identify the two species.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 1993-1997 was 9.9 spotted dolphins (*Stenella* sp.) CV = 0.09; Table 2).

Fishery Information

No spotted dolphin mortalities were observed in 1977-1991 foreign fishing activities. Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989 and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and 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 USA 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.

By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet and pelagic longline fisheries, but no mortalities or serious injuries have been documented in the pelagic pair trawl, New England multispecies sink gillnet, mid-Atlantic coastal gillnet, and North Atlantic bottom trawl fisheries; and no takes have been documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Pelagic Drift Gillnet

The estimated total number of hauls in the pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and 1996 were 233, 243, 232, 197, 164, and 149 respectively. In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Since 1994, between 10-12 vessels have participated in the fishery (Table 2). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. 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 pelagic drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 and 1995 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fisheries information. Variances were estimated using bootstrap re-sampling techniques. Forty-nine spotted dolphin mortalities were observed in the drift gillnet fishery between 1989 and 1996 and occurred northeast of Cape Hatteras within the 183 m isobath in February-April, and near Lydonia Canyon in October. Six whole animal carcasses that were sent to the Smithsonian were identified as Pantropical spotted dolphins (*S. attenuata*). The remaining animals were not identified to species. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 25 in 1989 (.65), 51 in 1990 (.49), 11 in 1991 (.41), 20 in 1992 (0.18), 8.4 in 1993 (0.40), 29 in 1994 (0.01), 0 in 1995, and 2 in 1996 (0.06); average annual mortality and serious injury during 1993-1997 was 9.9 (0.09) (Table 2).

Pelagic Longline

Interactions between the pelagic longline 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 effort, excluding the Gulf of Mexico, for the pelagic longline fishery, based on mandatory self-reported fisheries information, was 11,279 sets in 1991, 9,869 sets in 1992, 9,862 sets in 1993, 9,481 sets in 1994, 10,129 sets in 1995, 9,885 sets in 1996, and 8,023 sets in 1997 (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999). Since 1992, this fishery has been monitored with about 5% observer coverage, in terms of trips observed, within every statistical reporting area within the EEZ and beyond. Off the USA Atlantic coast, 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. Most of the estimated marine mammal by-catch was from EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999). The 1992-1997, estimated take was based on a revised analysis of the observed incidental take and self-reported incidental take and effort data, and replace previous estimates for the 1992-1993 and 1994-1995 periods (Scott and Brown 1997; Johnson *et al.* 1999). Excluding the Gulf of Mexico where one animal was hooked and released alive (Appendix 1), no Atlantic spotted dolphin bycatches were observed for 1992-1997. Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

Table 2. Summary of the incidental mortality of spotted dolphins (*Stenella* sp.) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated[6] Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Drift Gillnet[7]	93-96	1994=11[3] 1995=12 1996=10	Obs. Data Logbook	.42, .87, .99, .64, NA	0, 29, 0, 2, NA	8.4[4], 29, 0, 2, NA	.40, .01, 0, 0[5], NA	9.9 (.09)
Pelagic Longline	93-97	NA	Obs. Data Logbook	.06, .05, .06, .03, .04	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0
TOTAL								9.9 (.09)

1 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. Mandatory logbook (Logbook) data are used to measure total effort for the pelagic drift gillnet fishery, and these data are collected at the Southeast Fisheries Science Center (SEFSC).

2 The observer coverage for the pelagic drift gillnet and pair trawl fishery is measured in terms of sets, and the longline fishery is in trips.

3 1994 and 1995 shown, other years not available on an annual basis.

4 For 1991-1993, pooled bycatch rates were used to estimate bycatch in months that had fishing effort but did not have observer coverage. This method is described in Northridge (1996). In 1994 and 1995, observer coverage increased substantially, and bycatch rates were not pooled for this period .

5 Estimates were based on 2 seasons. The two observed takes were during the winter season when observer coverage was 100%.

6 Annual mortality estimates do not include any animals injured and released alive.

7 The fishery did not operate in 1997; the average annual mortality is based on the number of years (4; 1993-1996) that the fishery operated.

Table 3. Summary of spotted dolphins (*Stenella* sp.) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured)

Fishery	Years	Ratio	Injured[2]	Uninjured
Pelagic longline	93-97	0, 0, 0, 0, 0	0,1[1], 0, 0, 0	0, 1[1], 0, 0, 0

1 See Appendix 1.
2 Annual mortality estimates do not include any animals injured and released alive.

Other Mortality

From 1995-1997, eight Atlantic spotted dolphins were stranded between North Carolina and Florida (NMFS unpublished data).

STATUS OF STOCK

The status of Atlantic spotted dolphins, relative to OSP in the USA Atlantic EEZ 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. 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. The status of this stock has been changed from strategic to non-strategic because the estimated annual fishery-related mortality and serious injury are below PBR.

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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; 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 USA 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 pantropical spotted dolphins off the eastern USA coast is unknown; however, two abundance estimates are available for the combination of both spotted dolphin species within portions of the northeastern USA Atlantic during spring and summer of 1978-82, and July-September 1995 (Table 1; Figure 1). Neither survey distinguishes between the two species or covers important spotted dolphin habitat in the continental shelf between Cape Hatteras and Florida, or in oceanic waters.

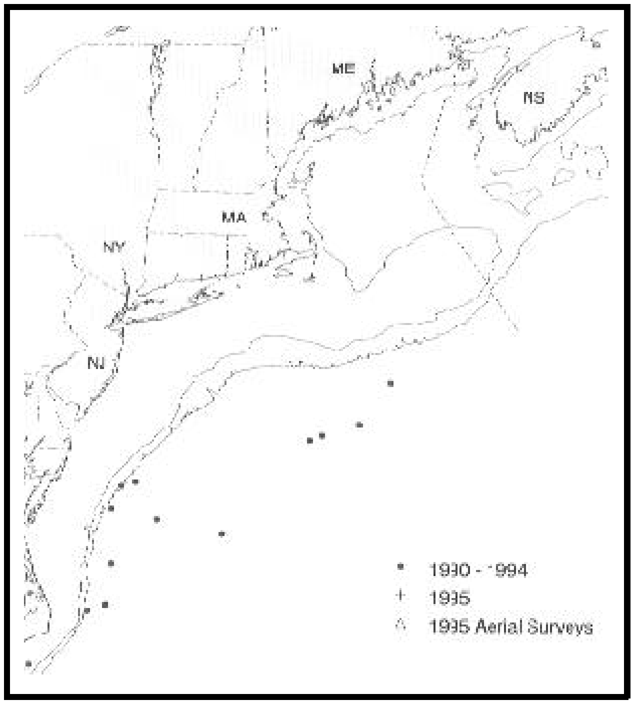

Figure 1. *Distribution of spotted dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

A population size of 6,107 spotted dolphins (CV=0.27) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). R. Kenney (pers. comm.) 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. The estimate is based on inverse variance-weighted pooling of the revised CETAP (1982) spring and summer data. An average of these seasons were chosen because the greatest proportion of the population off the northeast USA coast appeared in the study area during these seasons. This estimate does not include a correction for dive-time or g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its high degree of uncertainty, its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

Due to insufficient numbers of spotted dolphin sightings collected during the August 1990, June-July 1991, August-September 1991 and June-July 1993 sighting surveys spotted dolphin abundance was not estimated.

A population size of undifferentiated 4,772 (CV = 1.27) spotted dolphins was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS, unpublished data). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al.* 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey. An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time. Variability was estimated using bootstrap resampling techniques.

The best available current abundance estimate for the undifferentiated group of spotted dolphins is 4,772 (CV=1.27) as estimated from the July to September 1995 line transect survey (NMFS, unpublished data) because this survey is recent and provided the most complete coverage of the known habitat.

Table 1. Summary of abundance estimates for both species of spotted dolphins. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
spring & summer 1978-82	Cape Hatteras, NC to Nova Scotia	6,107	0.27
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	4,772	1.27

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for spotted dolphins is 4,772 (CV=1.27). The minimum population estimate for spotted dolphins is 1,617 (CV=1.27).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the undifferentiated group of spotted dolphins is 1,617 (CV=1.27). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the undifferentiated group of spotted dolphins combined is 16. However, it is not reasonable to calculate a PBR for the pantropical spotted dolphin alone, because it was impossible to separately identify the two species.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 1993-1997 was 9.9 spotted dolphins (*Stenella* sp.) CV = 0.09; Table 2).

Fisheries Information

No spotted dolphin mortalities were observed in 1977-1991 foreign fishing activities. Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989 and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and 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 USA 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.

By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet and pelagic longline fisheries, but no mortalities or serious injuries have been documented in the pelagic pair trawl, New England multispecies sink gillnet, mid-Atlantic coastal gillnet, and North Atlantic bottom trawl fisheries; and no takes have been documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Pelagic Drift Gillnet

The estimated total number of hauls in the pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and 1996 were 233, 243, 232, 197, 164, and 149 respectively. In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Since 1994, between 10-12 vessels have participated in the fishery (Table 2). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. 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 pelagic drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 and 1995 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fisheries information. Variances were estimated using bootstrap re-sampling techniques. Forty-nine spotted dolphin mortalities were observed in the drift gillnet fishery between 1989 and 1996 and occurred northeast of Cape Hatteras within the 183 m isobath in February-April, and near Lydonia Canyon in October. Six whole animal carcasses that were sent to the Smithsonian were identified as Pantropical spotted dolphins (*S. attenuata*). The remaining animals were not identified to species. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 25 in 1989 (.65), 51 in 1990 (.49), 11 in 1991 (.41), 20 in 1992 (0.18), 8.4 in 1993 (0.40), 29 in 1994 (0.01), 0 in 1995, and 2 in 1996 (0.06); average annual mortality and serious injury during 1993-1997 was 9.9 (0.09) (Table 2).

Pelagic Longline

Interactions between the pelagic longline 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. Total effort, excluding the Gulf of Mexico, for the pelagic longline fishery, based on mandatory self-reported fisheries information, was 11,279 sets in 1991, 9,869 sets in 1992, 9,862 sets in 1993, 9,481 sets in 1994, 10,129 sets in 1995, 9,885 sets in 1996, and 8,023 sets in 1997 (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999). Since 1992, this fishery has been monitored with about 5% observer coverage, in terms of trips observed, within every statistical reporting area within the EEZ and beyond. Off the USA Atlantic coast, 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. Most of the estimated marine mammal by-catch was from EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999). The 1992-1997, estimated take was based on a revised analysis of the observed incidental take and self-reported incidental take and effort data, and replace previous estimates for the 1992-1993 and 1994-1995 periods (Scott and Brown 1997; Johnson *et al.* 1999). Excluding the Gulf of Mexico where one animal was hooked and released alive (Appendix 1), no Pantropical spotted dolphin bycatches were observed for 1992-1997. Table 3 summarizes the number of animals released alive and classified as injured or non-injured. It also includes the ratio of observed to estimated mortalities for this fishery.

Table 2. Summary of the incidental mortality of spotted dolphins (*Stenella* sp.) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated[6] Mortality	Estimated CVs	Mean Annual Mortality
Pelagic[7] Drift Gillnet	93-97	1994=11[3] 1995=12 1996=10	Obs. Data Logbook	.42, .87, .99, .64, NA	0, 29, 0, 2, NA	[4], 8.4, 29, 0, 2, NA	.40, .01, 0, 0[5], NA	9.9[7] (.09)
Pelagic Longline	93-97	NA	Obs. Data Logbook	.06, .05, .06, .03, .04	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0, 0, 0	0
TOTAL								9.9 (.09)

1 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. Mandatory logbook (Logbook) data are used to measure total effort for the pelagic drift gillnet fishery, and these data are collected at the Southeast Fisheries Science Center (SEFSC).

2 The observer coverage for the pelagic drift gillnet and pair trawl fishery is measured in terms of sets, and the longline fishery is in trips.

3 1994 and 1995 shown, other years not available on an annual basis.

4 For 1991-1993, pooled bycatch rates were used to estimate bycatch in months that had fishing effort but did not have observer coverage. This method is described in Northridge (1996). In 1994 and 1995, observer coverage increased substantially, and bycatch rates were not pooled for this period .

5 Estimates were based on 2 seasons. The two observed takes were during the winter season when observer coverage was 100%.

6 Annual mortality estimates do not include any animals injured and released alive.

7 The fishery did not operate in 1997; the average annual mortality is based on the number of years (4; 1993- 1996) that the fishery operated.

Table 3. Summary of spotted dolphins (*Stenella* sp.) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured)

Fishery	Years	Ratio	Injured[2]	Uninjured
Pelagic longline	93-97	0, 0, 0, 0, 0	0,1[1], 0, 0, 0	0, 1[1], 0, 0, 0

[1] See Appendix 1.
[2] Annual mortality estimates do not include any animals injured and released alive.

Other Mortality

From 1995-1997, 15 Pantropical spotted dolphins were stranded between North Carolina and Florida (NMFS unpublished data). The 15 mortalities includes the 1996 mass stranding of 11 animals in Florida (NMFS unpublished data).

STATUS OF STOCK

The status of pantropical spotted dolphins, relative to OSP in the USA Atlantic EEZ 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. 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. The status of this stock has been changed from strategic to non-strategic because the estimated annual fishery-related mortality and serious injury are below PBR.

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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; Mead and Potter 1995; Curry and Smith 1997).

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 (Figure 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 (Figure 1) consistent with Kenney 1990. In Canadian waters, bottlenose dolphins have occasionally been sighted on the Scotian Shelf, particularly in the Gully (Gowans and Whitehead 1995; NMFS unpublished data). 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 USA Exclusive Economic Zone (EEZ) waters south of Cape Hatteras.

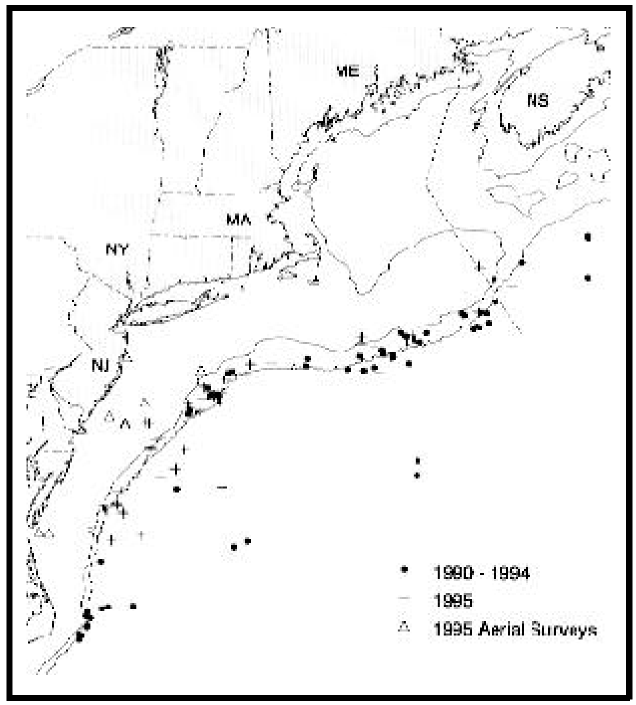

Figure 1. *Distribution of bottlenose dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

The total number of bottlenose dolphins off the Atlantic USA coast is unknown; however, six abundance estimates are available for portions of the northeastern USA Atlantic during fall of 1978-82, August 1990, June - July 1991, August-September 1991, June-July 1993, and July - September 1995 (Table 1 and Figure 1).

A population size of 7,696 offshore bottlenose dolphins (CV=0.58) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (Table 1; CETAP 1982). The estimate is based on fall data only, because the greatest proportion of the population off the northeast USA coast appeared in the study area the fall. This estimate does not include a correction for dive-time or g(0), the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its high degree of uncertainty (e.g., large CV), its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

A population size of 2,903 offshore bottlenose dolphins (CV=0.66) was estimated from an August 1990 shipboard line transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (Table 1; Waring *et al.* 1992). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 9,106 offshore bottlenose dolphins (CV=0.36) was estimated from a June and July 1991 shipboard line transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Table 1; Waring *et al.* 1992; Waring 1998). Data were collected by one team that searched by naked eye and analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but no corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 12,090 (CV=0.38) and 12,760 (CV=0.84) offshore bottlenose dolphins was estimated from line transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11, respectively (Table 1; Anon. 1991). The study area included that covered in the CETAP study plus several additional continental slope survey blocks. 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), where the CV was estimated using the bootstrap option. The abundance estimates do not include g(0) and were not pooled over platforms because the inter-platform calibration analysis has not been conducted.

A population size of 716 offshore bottlenose dolphins (CV=0.44) was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Table 1; Anon. 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993). Estimates include school size-bias, if applicable, but do not include corrections for g(0) or dive-time. Variability was estimated using bootstrap resampling techniques.

A population size of 13,453 offshore bottlenose dolphins (CV=0.54) was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; NMFS unpublished data). Total track line length was 32,600 km (17,600 nmi). The ships covered waters between the 50 and 1000 fathom contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom contour line. Shipboard data were collected using a two independent sighting team procedure and were analyzed using the product integral method (Palka 1995) and DISTANCE (Buckland *et al.* 1993). Shipboard estimates were corrected for g(0) and, if applicable, also for school size-bias. Standard aerial sighting procedures with two bubble windows and one belly window observer were used during the aerial survey. An estimate of g(0) was not made for the aerial portion of the survey. Estimates do not include corrections for dive-time. Variability was estimated using bootstrap resampling techniques.

Although the 1990-1995 surveys did not sample the same areas or encompass the entire offshore bottlenose dolphin habitat, they did focus on segments of known or suspected high-use habitats off the northeastern USA coast. The collective 1990-95 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 best available current abundance estimate for offshore bottlenose dolphins is 13,453 (CV=0.54) as estimated from the July to September 1995 line transect survey (NMFS unpublished data) because this survey is recent and provided the most complete coverage of the known habitat.

Table 1. Summary of abundance estimates for the western North Atlantic offshore bottlenose dolphin. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
fall 1978-82	Cape Hatteras, NC to Nova Scotia	7,676	0.58
Aug 1990	Gulf Stream	2,903	0.66
Jun-Jul 1991	Cape Hatteras, NC to Georges Bank, shelf edge only	9,106	0.36
Aug-Sep 1991	Cape Hatteras, NC to Nova Scotia	12,090 and 12,760*	0.38 and 0.84*
Jun-Jul 1993	Georges Bank to Scotian shelf, shelf edge only	716	0.44
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	13,453	0.54

* From data collected on the Twin Otter and AT-11, respectively.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for offshore bottlenose dolphins is 13,453 (CV=0.54). The minimum population estimate for the western North Atlantic offshore bottlenose is 8,794 (CV=0.54).

Current Population Trend

The data are insufficient to determine population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for offshore bottlenose dolphins is 8,794 (CV=0.54). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic offshore bottlenose dolphin is 88.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 1993-1997 was 10 bottlenose dolphins (CV = 0.07).

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 USA prior to 1977. A fisheries observer program which 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 USA 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 USA east coast. Between 1983 and 1991, the number of foreign fishing vessels operating within the USA 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 USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet, pelagic pair trawl, and North Atlantic bottom trawl fisheries, but no mortalities have documented in the Northeast multispecies sink gillnet and pelagic longline fisheries.

Pelagic Longline

The pelagic longline fishery operates in the USA Atlantic (including Caribbean) and Gulf of Mexico EEZ (SEFSC unpublished data). Interactions between the pelagic longline 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. Total effort, excluding the Gulf of Mexico, for the pelagic longline fishery, based on mandatory self-reported fisheries information, was 11,279 sets in 1991, 9,869 sets in 1992, 9,862 sets in 1993, 9,481 sets in 1994, 10,129 sets in 1995, 9,885 sets in 1996, and 8,023 sets in 1997 (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999). Since 1992, this fishery has been monitored with about 5% observer coverage, in terms of trips observed, within every statistical reporting area within the EEZ and beyond. Off the USA Atlantic coast, 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. The 1993-1997, estimated take was based on a revised analysis of the observed incidental take and self-reported incidental take and effort data, and replace previous estimates for the 1992-1993 and 1994-1995 periods (Cramer 1994; Scott and Brown 1997; Johnson *et al*. 1999). Most of the estimated marine mammal by-catch was from EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999). In 1993 two bottlenose dolphins were hooked and released alive (Table 3). The 1992-1997, estimated take was based on a revised analysis of the observed incidental take and self-reported incidental take and effort data, and replace previous estimates for the 1992-1993 and 1994-1995 periods (Scott and Brown 1997; Johnson *et al.* 1999).

Pelagic Drift Gillnet

The estimated total number of hauls in the pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls in 1991, 1992, 1993, 1994, 1995, and 1996 were 233, 243, 232, 197,164, and 149 respectively. In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnets (i.e., permanent closure) in the North Atlantic swordfish fishery (50 CFR Part 630). Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Since 1994, between 10-12 vessels have participated in the fishery (Table 2). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. 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 pelagic drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch for 1994 and 1995 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fisheries information. Variances were estimated using bootstrap re-sampling techniques. Fifty-seven bottlenose dolphin mortalities have been observed between 1989 and 1996. Estimated bottlenose dolphin kills (CV in parentheses) extrapolated for each year were 72 in 1989 (0.18), 115 in 1990 (0.18), 26 in 1991 (0.15), 28 in 1992 (0.10), 22 in 1993 (0.13), 14 in 1994 (0.04), 5 in 1995 (0), and zero in 1996. Mean annual estimated fishery-related mortality for this fishery in 1993-1997 was 10 bottlenose dolphins (CV = 0.07) (Table 2).

Pelagic Pair Trawl

Effort in the pelagic pair trawl fishery 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 536 hauls in 1992, 586 in 1993, 407 in 1994, and 440 in 1995, respectively. This fishery ceased operations in 1996, when NMFS rejected a petition to consider pair trawl gear as an authorized gear type in Atlantic tunas fishery. The fishery operated from August-November in 1991, from June-November in 1992, from June-October in 1993 (Northridge 1996), and from mid-summer to November in 1994 and 1995. Sea sampling began in October 1992 (Gerrior *et al*. 1994), and 48 sets (9% of the total) were sampled in that season, 102 hauls (17% of the total) were sampled in 1993. In 1994 and 1995, 52% and 55%, respectively, of the sets were observed. 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 1996). Thirty-two bottlenose dolphin mortalities were observed between 1991 and 1995. Estimated annual fishery-related mortality (CV in parentheses) was 13 dolphins in 1991 (0.52), 73 in 1992 (0.49), 85 in 1993 (0.41), 4 in 1994 (0.40) and 17 in 1995 (0.26). Since this fishery no longer exists, it has been excluded from Tables 2 and 3. During the 1994 and 1995 experimental fishing seasons, fishing gear experiments were conducted to collect data on environmental parameters, gear behavior, and gear handling practices to evaluate factors affecting catch and bycatch (Goudey 1995, 1996). Results of these studies have been presented at Offshore Cetacean Take Reduction Team Meetings.

North Atlantic Bottom Trawl:

Vessels in the North Atlantic bottom 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). Since 1992 there were no bottlenose mortalities observed in this fishery.

Squid, Mackerel and Butterfish:

The mid-Atlantic mackerel and squid trawl fisheries were combined into the Atlantic squid, mackerel and butterfish trawl fishery in 1996. These fisheries operate seasonally, principally in the USA mid-Atlantic and southern New England continental shelf region. 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. In 1996, mackerel, squid, and butterfish trawl fisheries were combined into the Atlantic squid, mackerel, and butterfish trawl fishery, and maintained a Category II classification. 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 the self-reported fisheries information from the mackerel trawl fishery between 1990-1992.

Table 2. Summary of the incidental mortality of bottlenose dolphins (*Tursiops truncatus*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Drift Gillnet[6]	93-97	1994=12[3] 1995=11 1996=10	Obs. Data Logbook	.42, .87, .99, .64, NA	6, 12, 5, 0, NA	22, 13, 5.0[4], 0, NA	.13, .05, 0, 0, NA	(10) (0.07)
TOTAL								(10) (0.07)

1 Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects weighout (Weighout) landings data, and total landings are used as a measure of total effort for the coastal gillnet fishery and trips are used as total effort for the North Atlantic bottom trawl fishery. Mandatory logbook (Logbook) data are used to measure total effort for the pelagic drift gillnet fishery, and these data are collected at the Southeast Fisheries Science Center (SEFSC).

2 The observer coverage for the pelagic drift gillnet and pair trawl fishery is measured in terms of sets, and the North Atlantic bottom trawl fishery is in days fished. Assessments for the coastal gillnet fishery have not been completed. The number of trips sampled by the NEFSC Sea Sampling Program are reported here.

3 1994-1996 shown, other years not available on an annual basis.

4 One vessel was not observed and recorded 1 set in a 10 day trip in the SEFSC mandatory logbook. If you assume the vessel fished 1.4 sets per day as estimated from the 1995 SS data, the point estimate may increase by 0.42 animals. However, the SEFSC mandatory logbook data was taken at face value, and therefore it was assumed that 1 set was fished within this trip, and the point estimate would then increase by 0.03 animals.

5 Annual mortality estimates do not include any animals injured and released alive.

6 The fishery did not operate in 1997; the average annual mortality is based on the number of years (4; 1993-1996) that the fishery operated.

Table 3. Summary of bottlenose dolphins (Tursiops truncatus) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured)

Fishery	Years	Ratio	Injured[1]	Uninjured
Pelagic Longline	93-97	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0

1 Injured and released alive animals are not included in the Table 2 mortality estimates.

Other Mortality

Bottlenose dolphins are one of the most frequently stranded small cetacean along the Atlantic coast. Many of the animals show signs of human interaction (i.e., net marks, mutilation, etc.). The estimated number of animals that represent the offshore stock are presently under evaluation.

STATUS OF STOCK

The status of this stock relative to OSP in the Atlantic EEZ is unknown. The western north Atlantic offshore bottlenose dolphin 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 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. Average 1993-1997 annual fishery-related mortality and serious injury does not exceed the PBR; therefore, this is not a strategic stock.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two distinct bottlenose dolphin ecotypes (Duffield *et al.* 1983; Duffield 1986; Mead and Potter 1995; Walker *et al.* in press); a shallow, warm water ecotype and a deep, cold water ecotype which correspond to nearshore and offshore forms, respectively. Both ecotypes have been shown to inhabit waters in the western North Atlantic Ocean (Hersh and Duffield 1990; Mead and Potter 1995; Hoelzel *et al.* 1998; Walker *et al.* in press). The inshore and offshore forms, of all age classes, can be positively identified based on differences in morphometrics, parasite loads, and prey (Mead and Potter 1995). Hoelzel *et al.* (1998) found significant differentiation between the nearshore and offshore forms in both nuclear and mtDNA markers, and concluded the two forms were distinct. Curry (1997) concluded that, based on differences in mtDNA haplotypes, the nearshore animals in the northern Gulf of Mexico and the western North Atlantic were significantly different stocks. 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 USA 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 or nearshore form. Furthermore, Hoelzel *et al.* (1998) genetically identified a sample of animals captured or incidentally caught in nearshore waters as the nearshore form. Currently, data are insufficient to allow separation of locally resident bottlenose dolphins found in bays, sounds and estuaries (such as those from the Indian/Banana River) from the coastal stock in the western North Atlantic; Hoelzel *et al.* (1998) found less variation in nuclear and mtDNA markers among their sample of nearshore animals, which likely included resident and coastal animals, than their sample of offshore animals.

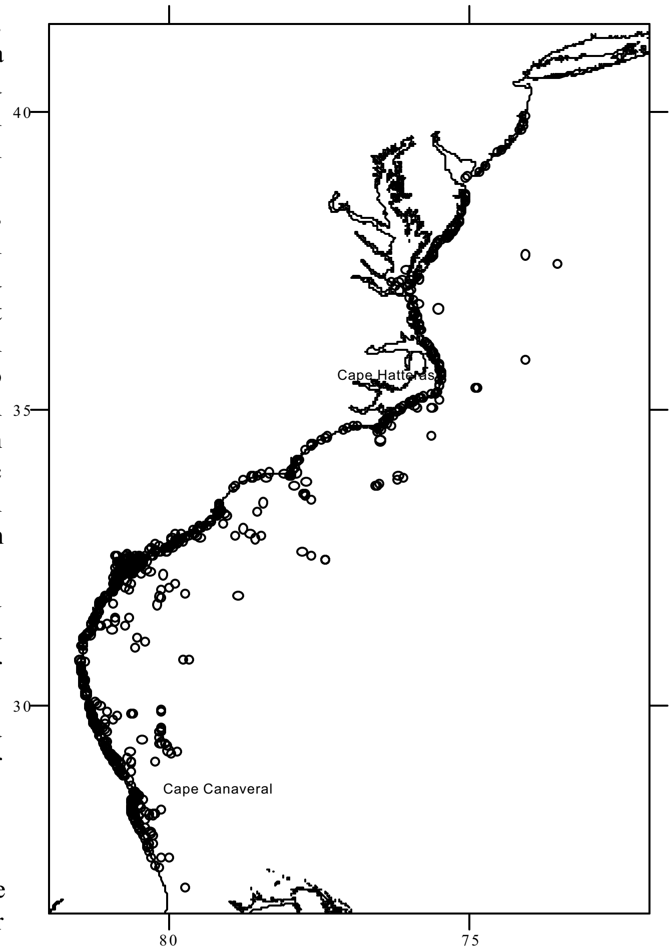

Figure 1. *Sightings of bottlenose dolphins during aerial surveys from shore to the 25 m isobath north of Cape Hatteras during summer 1994, shore to 9 km past the western Gulf Stream wall south of Cape Hatteras during winter 1992, three coastal surveys within one km of shore from New Jersey to mid-Florida during the summer in 1994, and during vessel surveys from about the 30 m isobath to the offshore extent of the US EEZ in 1998.*

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. Some 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 concentration of bottlenose dolphins centered on the 25 m isobath which was observed during aerial surveys of the region (CETAP 1982) and vessel surveys (NMFS unpublished data). 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).

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 USA Atlantic coast. Figure 1 illustrates the distribution of 696 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), within one km of the shore from New Jersey to mid-Florida during three replicate coastal surveys conducted during the summer in 1994 (Blaylock 1995), and from about the 30 m isobath to the offshore extent of the USA Exclusive Economic Zone (EEZ) during a vessel survey for pelagic cetaceans in 1998 (NMFS unpublished data). 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. Gathering information to distinguish between coastal and offshore ecotypes is currently an active area of research by the NMFS Southeast Fisheries Science Center (SEFSC), as is research to determine the relationship between bottlenose dolphin that inhabit bays, sounds and estuaries and those that are believed to comprise the coastal stock (Hohn 1997).

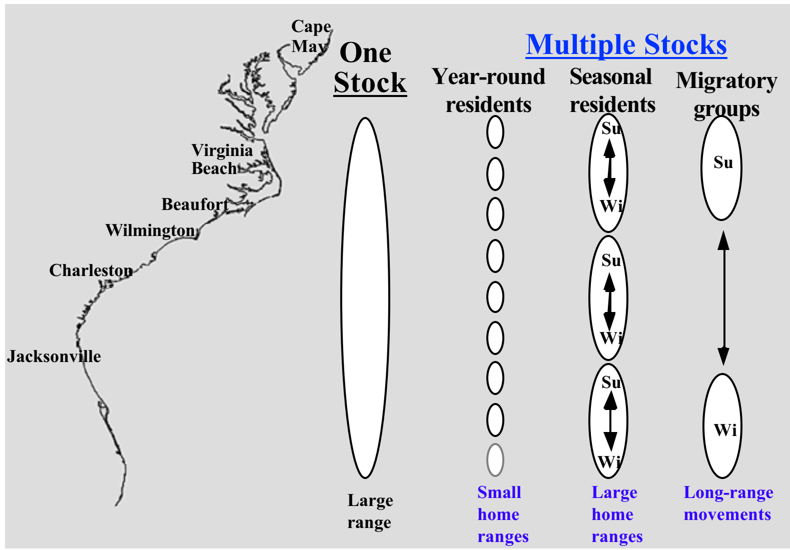

Figure 2. *Illustration of stock structure hypotheses of Atlantic coastal bottlenose dolphins: one stock ranging from New Jersey to Florida or multiple stocks which may include: 1) year-round residents with small home ranges; 2) multiple, contiguous, seasonally resident groups with relatively large home ranges; and 3) groups with long-range migratory pattern.*

A multi-disciplinary, multi-investigator research program to determine the stock structure of Atlantic coastal bottlenose dolphins was initiated in late 1996. Figure 2 illustrates the stock structure hypotheses that are being considered. The experimental design for the program is based on: 1) obtaining samples from live captures, photo-identification, projectile biopsy, and incidental take (strandings and observer programs); 2) conducting independent analyses including genetics, isotope ratios, contaminants, movement patterns, morphometrics, telemetry, and life history; and 3) merging of the disassociated results to describe stock structure (Hohn 1997). Based on current information, it is expected that multiple stocks exist and include year-round residents, seasonal residents, and migratory groups.

Site-specific, year-round residents have been reported only in the southern part of the range, from Charleston, SC (Zolman 1996) and Georgia (Petricig 1995) to central Florida (Odell and Asper 1990); seasonal residents and migratory or transient animals also occur in these areas. In the northern part of the range the patterns reported include seasonal residency, year-round residency with large home range, and migratory or transient movements (Barco and Swingle 1996, Sayigh *et al*. 1997). Table I lists the locations and the patterns of residency and movement that have been documented

Table I. *Residency and movement patterns of bottlenose dolphins documented from photo-identification (from Hohn 1997).*

<table>
<tr><th>Location</th><th>Year-round Residents</th><th>Seasonal Residents</th><th>Migratory/ Transient</th></tr>
<tr><td>Virginia Beach, VA</td><td>No</td><td>Jun-Sept</td><td>Jun-Sept</td></tr>
<tr><td>Beaufort, NC, “coastal”</td><td>No</td><td>Oct-Apr</td><td>?</td></tr>
<tr><td>Beaufort, NC, “estuarine”</td><td colspan="2" rowspan="2">Possible large home range</td><td></td></tr>
<tr><td>Wilmington, NC</td><td></td></tr>
<tr><td>Charleston, SC</td><td>Yes</td><td>fall-winter</td><td>spring, fall</td></tr>
</table>

through photo-identification of naturally-marked animals, and of 31 individuals animals that were live-captured and freeze-branded in Beaufort, NC in 1995 (Hansen and Wells 1996). Complex patterns of movement and residency were observed in a sample of 10 of the animals live-captured in Beaufort that were radio-tagged and tracked for up to 31 days: some left the area immediately, some were located up to 120 km distant within a few days of tagging, and others remained in the area (Read *et al*. 1996).

The observed patterns of year-round residency and seasonal residency, and migratory and transient movements likely represent a population that consists of a complex mosaic of biologically-meaningful stocks. The patterns are in some cases essentially identical or very similar to patterns observed in recognized stocks or communities identified in embayments and coastal areas in the northern Gulf of Mexico (e.g. Scott*et al*. 1990; Weller 1998; Wells*et al*. 1996). Sufficient information exists to identify year-round resident communities in several bay and estuarine areas; however, much of the suitable bay and estuarine habitats along the Atlantic coast have not yet been studied sufficiently. Although numerous research efforts are underway, it will require several years of photographic identification, genetic and radio-tracking research to provide sufficient information for interpretation. The entire range(s) and number of migratory and transient stocks are unknown, but much of the current research effort is directed towards determining stock structure, movements, and degree of mixing of these presumed stocks. As the research efforts are completed, it is likely that a number of stocks or communities will be identified, including year-round and resident stocks in embayments, and transient or migratory stocks. This will necessitate a revision of the report of Western North Atlantic Coastal Stock of bottlenose dolphins to reflect the number of stocks described.

POPULATION SIZE

Mitchell (1975) estimated that the coastal bottlenose dolphin population which was exploited by a shore-based net fishery until 1925 (Mead 1975) numbered at least 13,748 bottlenose dolphins in the 1800s. Recent estimates of bottlenose dolphin abundance in the USA 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 was conducted during February-March 1992 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 about 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). An aerial survey was conducted during late January-early March 1995, following nearly the same design as the 1992 survey. Preliminary analysis (following the same procedures described above) resulted in an abundance estimate of 21,128 dolphins (CV = 0.22) with a long-normal 95% confidence interval of 13,815-32,312.

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. An aerial survey of this area was conducted during mid July-mid August 1995. Data from the pilot study was used to design this survey; survey sampling was designed to produce an abundance estimate with a CV of 0.20 or less. Preliminary analysis (following the same procedures described above for the surveys south of Cape Hatteras) resulted in an abundance estimate of 12,570 dolphins (CV = 0.19) with a log-normal 95% confidence interval of 8,695-18,173.

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.

A vessel survey to obtain abundance, distribution, and biopsy information from pelagic cetaceans in USA waters south of Delaware Bay was conducted during July and August 1998 (NMFS unpublished data). The survey included waters from approximately the 30 m isobath out to the offshore extent of the USA EEZ. A total of 56 herds or groups of bottlenose dolphins were sighted; an unknown number of these herds were likely the offshore bottlenose dolphin ecotype. One of the herds sighted was exceptionally large and was estimated to consist of 251 individuals. The data from the survey are currently being analyzed; abundance estimates should be available in late 1999.

It is not currently possible to distinguish the two bottlenose dolphin ecotypes with certainty during visual aerial and vessel surveys, as the distribution of the two ecotypes in USA Atlantic EEZ waters is uncertain. Because of this difficulty, the resulting abundance estimates may include dolphins from the offshore stock. Until additional research provides information to determine the range of habitat utilized by both ecotypes and their degree of mixing along the Atlantic coast, it will not be possible to assess the abundance of either type with any certainty. Determining the degree of geographic mixing of these two ecotypes is currently an active area of research by the NMFS, SEFSC.

Minimum Population Estimate

Reasonable assurance of a minimum population estimate can not be provided by line transect surveys because the proportion of dolphins from the offshore stock which might have been observed is unknown. The risk averse approach is to assume that the minimum population size is 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 USA 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 1992 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. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a "recovery" factor (Wade and Angliss 1997). The "recovery " factor, which accounts for endangered, depleted, and threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.50 because this stock is listed as depleted under the Marine Mammal Protection Act. Therefore, PBR for the USA Atlantic coastal bottlenose dolphin stock is 25 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Bottlenose dolphins are known to interact with commercial fisheries and occasionally are taken in various kinds of fishing gear including gillnets, seines, long-lines, shrimp trawls, and crab pots (Read 1994, Wang *et al*. 1994) especially in near-shore areas where dolphin densities and fishery efforts are greatest. These interactions are due in part to the species' gregarious nature and habits of feeding on discarded bycatch and from baited gear (e.g., long-line and crab pots). However, 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. In addition, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction. Due to the extent of decomposition and/or the level of experience of the examiner, a determination cannot always be made as to whether or not a stranding occurred due to human interaction

From 1993-1997, two hundred and eighty-eight bottlenose dolphins were reported stranded in waters north of Cape Hatteras (Virginia to Massachusetts, NE Region) (NMFS, unpublished data). The majority of the strandings within this northern area occurred in Virginia (n = 182, 63%). An unknown number of the animals reported stranded during 1993-1995 have shown signs of entanglement with fishing gear or interactions with fishing activities; however, limited information was available for 1993, and complete information was available for 1996-1997. 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). In 1996, seventy-four bottlenose dolphins were reported stranded in the NE Region. The cause of death could be determined for 44 animals and of these, 16 or 36% were reported due to human interactions (including 13 gear entanglements). In 1997, seventy-four bottlenose dolphins were also reported stranded in the NE Region. The cause of death could be determined for 54 animals and of these, 14 or 26% were reported due to human interactions. If the percentages are consistent for animals for which cause of death could not be determined, it is likely that during 1996 about 27 (36%), and during 1997 about 19 (26%), of the stranded animals in the NE Region died due to human interactions.

Table II. *Bottlenose dolphin strandings in the U.S. Southeast Atlantic (North Carolina to Florida) from 1993 to 1997. Data from Southeast Marine Mammal Stranding Database (SEUS).*

State	1993	1994	1995	1996	1997	Total
North Carolina						
No. Stranded	78	51	80	70	127	406
No. Human Interactions	18	14	18	14	36	100
% With Human Interactions	23%	27%	22%	20%	28%	25%
South Carolina						
No. Stranded	33	19	32	29	41	154
No. Human Interactions	1	1	3	5	9	19
% With Human Interactions	3%	5%	9%	17%	22%	12%
Georgia						
No. Stranded	29	13	17	17	18	94
No. Human Interactions	0	3	1	2	1	7
% With Human Interactions	0%	23%	6%	12%	6%	7%
Florida						
No. Stranded	111	62	91	104	104	472
No. Human Interactions	6	6	2	1	7	22
% With Human Interactions	5%	10%	2%	1%	7%	5%
Puerto Rico						
No. Stranded	0	1	1	1	0	3
No. Human Interactions	0	0	0	1	0	1

Evidence of interaction with fisheries (entanglement, net marks, mutilations, gun shots, etc.) were present in 149 of 1,129 (13%) of the bottlenose dolphin strandings investigated in the USA Southeast Atlantic region (North Carolina to Florida) from 1993 to 1997 (Table II) as determined from evidence of entanglement in fishing gear and/or other human related causes (e.g., net marks, entanglement, mutilations, boat strikes, gunshot wounds) (NMFS unpublished information). This does not take into account those animals for which cause of death could not be determined so the number of animals that stranded due to human interaction is likely greater.

North Carolina stranding records show the highest incidence of fishery interactions from the SE Atlantic Region. North Carolina data from 1993 through 1997 indicate that 100 of 406 animals, or 25% showed evidence of human interactions. In 1997, 127 bottlenose dolphin stranded in North Carolina. Cause of death could be determined for only 58 of these animals, and of these 36 or 62.1% exhibited positive signs of fisheries interactions. If this percentage is consistent for all North Carolina stranded animals, it is possible that approximately 78 or 62% of the stranded animals died from human interactions in 1997.

Fishery Information

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). Menhaden purse seiners have reported an annual incidental take of one to five bottlenose dolphins (NMFS 1991, pp. 5-73), although observer data are not available.

Coastal gillnets operate in different seasons targeting different species in different states throughout the range of this stock. Most nets are

Table III. *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

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). It is considered likely that a few bottlenose dolphins are taken in this fishery each year (Read 1994). The portion of the fishery which operates along the South Carolina coast was sampled by observers during 1994 and 1995, and no fishery interactions were observed (McFee *et al*. 1996). 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 III.

Observer coverage of the USA Atlantic coastal gillnet fisheries for monkfish and dogfish, primarily, was initiated by the NEFSC Sea Sampling program in July, 1993. From July to December 1993, 20 trips were observed. By 1996, 350 trips were observed, representing about less than 5% coverage. This coastal gillnet 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. Still, only one bottlenose dolphins has been taken in the observed trips, despite large numbers of stranded dolphins with signs of fishery interactions indicative of gillnets.

Because this observer program was not covering those components of the coastal gillnet complex believed to be responsible for most of the interactions with coastal bottlenose dolphins, the NMFS initiated an observer program in 1997 to better define the various components of the coastal gillnet fisheries and place observers on representative fishing vessels to obtain statistically reliable information on takes of bottlenose dolphin. Although no takes of bottlenose dolphin were observed in 1997, three dolphins were observed taken in fisheries operating off Virginia and North Carolina in 1998 (NMFS unpublished data).

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 III. One bottlenose dolphin was recovered dead from a shrimp trawl in Georgia in 1995 (Southeast USA 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. No by-catch of marine mammals has been reported to NMFS. In recent years reports of strandings with evidence of interactions between bottlenose dolphin and both recreational and commercial crab-pot fisheries have been increasing in the Southeast region (McFee and Brooks 1998).

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 review).

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.

Although there are limited observer data directly linking serious injury and mortality to fisheries (e.g., in the coastal gillnet fishery complex in the mid-Atlantic), the total number of bottlenose dolphin assumed from this stock which stranded showing signs of fishery or human-related mortality exceeded PBR in 1993, 1996, 1997, and by the end of October in 1998. In North Carolina alone, human-related mortality approached PBR in each of the intervening years. 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.

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.

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October 1999

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

This stock is found in USA and Canadian Atlantic waters. The distribution of harbor porpoises has been documented by sighting surveys, strandings, and takes reported by NMFS observers in the Sea Sampling Program. During 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 1995a, b). During fall (October-December) and spring (April-June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south. They are seen from the coastline into the middle of the Gulf of Maine (> 200 m deep). During winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada. There does not appear to be a temporally coordinated migration or a specific migratory route to and from the Bay of Fundy region. Though, during the fall, several satellite tagged harbor porpoises did favor the waters around the 92m isobath, which is consistent with observations of high rates of incidental catches in this depth range (Read and Westgate 1997). There were two stranding records from Florida (Smithsonian strandings data base).

Gaskin (1984, 1992) proposed that there were four separate populations in the western North Atlantic: the Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland and Greenland populations. Recent analyzes involving mtDNA (Wang *et al*. 1996), organochlorine contaminants (Westgate *et al*. 1997), heavy metals (Johnston 1995), and life history parameters (Read and Hohn 1995) support Gaskin's proposal. In particular, there is a suggestion that the Gulf of Maine/Bay of Fundy females are different than Gulf of St. Lawrence females, but males were statistically indistinguishable (Palka *et al*. 1996). Research on microsatellites, a potentially powerful genetic tool, 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

To estimate the absolute population size of harbor porpoises aggregated in the Gulf of Maine/Bay of Fundy region, three line-transect sighting surveys were conducted during the summers of 1991, 1992 and 1995 (Table 1; Figure 1).

The population sizes were 37,500 harbor porpoises in 1991 (CV = 0.29, 95% confidence interval (CI) = 26,700-86,400) (Palka 1995a), 67,500 harbor porpoises in 1992 (CV = 0.23, 95% CI = 32,900-104,600), and 74,000 harbor porpoises in 1995 (CV=0.20, 95% CI = 40,900-109,100) (Palka 1996). The inverse variance weighted-average abundance estimate (Smith *et al*. 1993) was 54,300 harbor porpoises (CV = 0.14, 95% CI = 41,300-71,400). Possible reasons for inter-annual differences in abundance and distribution include experimental error and inter-annual changes in water temperature and availability of primary prey species (Palka 1995b).

The shipboard sighting survey procedure used in all three surveys involved two independent teams on one ship that searched using the naked eye in non-closing mode. Abundance, corrected for g(0), the probability of detecting an animal group on the track line, was estimated using the direct-duplicate method (Palka 1995a) and variability was

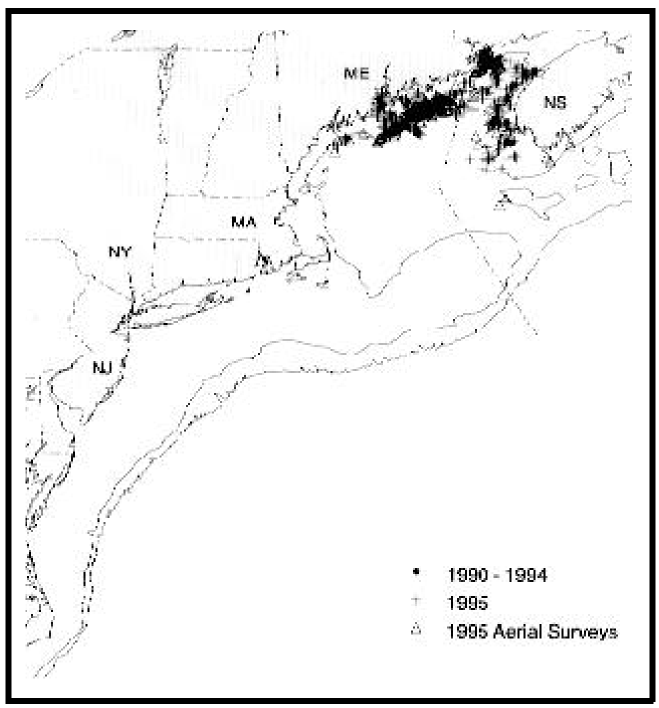

Figure 1. *Distribution of harbor porpoise sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

estimated using bootstrap re-sampling methods. Potential biases not explicitly accounted for are ship avoidance and time of submergence. During 1995 a small section of the region was surveyed by airplane while the rest of the region was surveyed by ship, as in previous years. An abundance estimate including g(0) was estimated for both the plane and ship (Palka 1996). During 1995, in addition to the Gulf of Maine/Bay of Fundy area, waters from Virginia to the mouth of the Gulf of St. Lawrence were surveyed and no harbor porpoises were seen except in the vicinity of the Gulf of Maine/Bay of Fundy.

Table 1. Summary of abundance estimates for the Gulf of Maine/Bay of Fundy harbor porpoise. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Area	N_{best}	CV
Jul-Aug 1991	N. Gulf of Maine & lower Bay of Fundy	37,500	0.29
Jul-Sep 1992	N. Gulf of Maine & lower Bay of Fundy	67,500	0.23
Jul-Sep 1995	N. Gulf of Maine & lower Bay of Fundy	74,000	0.20
Inverse variance-weighted average of above 1991, 1992 and 1995 estimates		54,300	0.14

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for harbor porpoises is 54,300 (CV=0.14). The minimum population estimate for the Gulf of Maine/Bay of Fundy harbor porpoise is 48,289 (CV=0.14).

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 Gulf of Maine/Bay of Fundy 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 a likely annual growth rate of 4%. In an attempt to estimate the potential population growth rate which incorporated many of the uncertainties in survivorship and reproduction, Caswell *et al*. (1998), using a Monte Carlo method to calculate a probability distribution of growth rates, estimated the median potential annual rate of increase is be approximately 10%, with a 90% confidence interval of 3-15%. This analysis underscored the considerable uncertainty that exists regarding the potential rate of increase in this population. Consequently, for the purposes of this assessment, the maximum net productivity rate was assumed to be 0.04, consistent with values used for other cetaceans for which direct observations of maximum rate of increase are not available. The 0.04 value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 48,289 (CV=0.14). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the Gulf of Maine/Bay of Fundy harbor porpoise is 483.

ANNUAL HUMAN-CAUSED MORTALITY

Fishery Information

Gulf of Maine/Bay of Fundy harbor porpoise takes have been documented in the USA New England multispecies sink gillnet, Mid-Atlantic coastal gillnet, Atlantic pelagic drift gillnet fisheries, and in the Canadian Bay of Fundy groundfish sink gillnet and herring weir fisheries. The USA average annual mortality estimate for 1993 to 1997 from the above USA fisheries is 1,704 (CV=0.09) harbor porpoises (Table 2). The Canadian average annual mortality estimate for 1993 to 1997 from the above Canadian fisheries is 146 harbor porpoises. It was not possible to estimate variance of the Canadian estimate. The total average annual mortality estimate for 1993 to 1997 from the USA and Canadian fisheries is 1,850 (Table 2).

USA

Recent data on incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. From late 1992, the SEFSC provided observer coverage of pelagic long line vessels fishing off the Grand Banks (Tail of the Banks) and south of Cape Hatteras.

New England Multispecies Sink Gillnet

Most of the harbor porpoise takes from USA fisheries are from the New England multispecies sink gillnet fishery. In 1984 the New England multispecies sink gillnet fishery was investigated by a sampling program that collected information concerning marine mammal by-catch. 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).

In 1990, an observer program was started by the NMFS to investigate marine mammal takes in the New England multispecies sink gillnet fishery. There have been 411 harbor porpoise mortalities related to this fishery observed between 1990 and 1997 and one was released alive uninjured. In 1993, there were approximately 349 full and part-time vessels in the New England multispecies sink gillnet fishery, which covered the Gulf of Maine and southern New England (Table 2). 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 1996) and their fishing effort was not used in estimating mortality. Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5% 4%, and 6% for years 1990 to 1997, respectively. 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. 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. By-catch estimates included 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 (1994), CUD (1994), and Bravington and Bisack (1996). These revised by-catch estimates replace those published earlier (Smith *et al.* 1993). These estimates are still negatively biased because they do not include harbor porpoises that fell out of the net while still underwater. This bias cannot be quantified at this time. Estimated annual by-catch (CV in parentheses) from this fishery during 1990-1997 was 2,900 in 1990 (0.32), 2,000 in 1991 (0.35), 1,200 in 1992 (0.21), 1,400 in 1993 (0.18) (Bravington and Bisack 1996; CUD 1994), 2100 in 1994 (0.18), 1400 in 1995 (0.27) (Bisack 1997a), 1200 (0.25) in 1996, and 775 (0.24) in 1997. Average estimated harbor porpoise mortality and serious injury in the New England multispecies sink gillnet fishery during 1993-1997 was 1,375 (0.10).

There appeared to be no evidence of differential mortality in USA or Canadian gillnet fisheries by age or sex in animals collected before 1994, although there was substantial inter-annual variation in the age and sex composition of the by-catch (Read and Hohn 1995). However, with a larger sample, from harbor porpoises examined by necropsy or from tissues received from sea sampling observers (n=171 between 1989 and 1997), the sex ratio is now 58 females and 113 males (A. Read, pers com). Investigations are currently underway to determine spatial-temporal patterns in the sex ratio.

Two preliminary experiments, using acoustic alarms (pingers) attached to gillnets, that were conducted in the Gulf of Maine during 1992 and 1993 took 10 and 33 harbor porpoises, respectively. During fall 1994, a controlled scientific experiment was conducted in the southern Gulf of Maine, where all nets with and without active pingers were observed (Kraus *et al.* 1997). In this experiment 25 harbor porpoises were taken in 423 strings with non-active pingers (controls) and two harbor porpoises were taken in 421 strings with active pingers. In addition, 17 other harbor porpoises were taken in nets that did not follow the experimental protocol (Table 2). From 1995 to 1997, experimental fisheries were conducted where all nets in a designated area were required to used pingers and only a sample of the nets were observed. During November-December 1995, the experimental fishery was conducted in the southern Gulf of Maine (Jeffreys Ledge) region, where no harbor porpoises were observed taken in 225 pingered nets. During 1995, all takes from pingered nets were added directly to the estimated total by-catch for that year. During April 1996, three other experimental fisheries occurred. In the Jeffreys Ledge area, in 88 observed hauls using pingered nets nine harbor porpoises were taken. In the Massachusetts Bay region, in 171 observed hauls using pingered nets two harbor porpoises were taken. And, in a region just south of Cape Cod, in 53 observed hauls using pingered nets no harbor porpoises were taken. During 1997, experimental fisheries were allowed in the midcoast region during March 25 to April 25 and November 1 to December 31. During the 1997 spring experimental fishery, out of 538 observed hauls using pingered nets five harbor porpoises were taken. During the 1997 fall experimental fishery, out of 125 observed hauls using pingered nets no harbor porpoises were taken.

From 95 stomachs of harbor porpoises collected in groundfish gillnets in the Gulf of Maine between September and December 1989-94, Atlantic herring (*Clupea harengus*) was the most important prey. Pearlsides (*Maurolicus weitzmani*), silver hake (*Merluccisu bilinearis*) and red and white hake (*Urophycis* spp.) were the next most common prey species (Gannon *et al.* 1998).

Mid-Atlantic Coastal Gillnet

Before an observer program was in place, Polacheck *et al.* (1995) reported one harbor porpoise incidentally taken in shad nets in the York River, Virginia. In July 1993 an observer program was initiated in the USA Atlantic coastal gillnet fishery by the NEFSC Sea Sampling program. 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. Twenty trips were observed during 1993. During 1994 and 1995, 221 and 382 trips were observed, respectively. Observer coverage, expressed as percent of tons of fish landed, was 5% for 1995, 4% for 1996, and 3% for 1997 (Table 2). No harbor porpoises were taken in observed trips during 1993 and 1994. During 1995 to 1997, respectively, 6, 19, and 32 harbor porpoises were observed taken (Table 2). Observed fishing effort has been concentrated off NJ and scattered between DE and NC from the beach to 50 miles off the beach. Documented by-catches during 1995 and 1997 were mostly from January to April, with the exception of one taken during May 1997, and one taken during December 1997. By-catch estimates were calculated using methods similar to that used for by-catch estimates in the New England multispecies gillnet fishery (Bravington and Bisack 1996; Bisack 1997a). Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 103 (0.57) for 1995, 311 (0.31) for 1996, and 572 (0.35) for 1997. Average estimated harbor porpoise mortality and serious injury from the Mid-Atlantic coastal gillnet fishery during 1995 to 1997 was 329 (CV=0.23) (Table 2).

Pelagic Drift Gillnet

In 1996 and 1997, the NMFS issued management regulations which prohibited the operation of this fishery in 1997. Further, in January 1999 the NMFS issued a Final Rule to prohibit the use of driftnet gear in the North Atlantic swordfish fishery (50 CFR Part 630). One harbor porpoise was observed taken from the 1991-1996 Atlantic pelagic drift gillnet fishery. The estimated total number of hauls in the Atlantic pelagic drift gillnet fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994, 1995, and 1996 there were 11, 12, and 10 vessels, respectively, in the fishery (Table 2). The estimated number of hauls in 1991, 1992, 1993, 1994, 1995 and 1996 were 233, 243, 232, 197, 164, and 149 respectively. Observer coverage, expressed as percent of sets observed was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, and 64% in 1996. The decline in observer coverage in 1996 is attributable to trips made by vessels that were deemed unsafe for observers due to the size or condition of the fishing vessel. Fishing effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras. Examination of the species composition of the catch and locations of the fishery throughout the year suggested that the drift gillnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum. Estimates of the total by-catch, for each year from 1989 to 1993, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Estimates of total annual by-catch after 1993 were estimated from the sum of the observed caught and the product of the average by-catch per haul and the number of unobserved hauls as recorded in logbooks. Variances were estimated using bootstrap re-sampling techniques (Bisack 1997b). The one observed by-catch was notable because it occurred in continental shelf edge waters adjacent to Cape Hatteras (Read *et al.* 1996). 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 (1.00), 0.4 in 1992 (1.00), 1.5 in 1993 (0.34), and 0 in 1994 to1996. The fishery was closed during 1997. Average estimated harbor porpoise mortality and serious injury in the Atlantic pelagic drift gillnet fishery during 1993-1996 was 0.4 (0.34) (Table 2).

North Atlantic Bottom Trawl

One harbor porpoise mortality was observed in the North Atlantic bottom trawl fishery between 1989 and 1997. Vessels in this 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. The one 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.

CANADA

Bay of Fundy Sink Gillnet

During the 1980's, Canadian harbor porpoise by-catch in the Bay of Fundy sink gillnet fishery, based on casual observations and discussions with fishermen, was thought to be low. The estimated harbor porpoise by-catch in 1986 was 94-116 and in 1989 it was 130 (Trippel *et al.* 1996). 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. Polacheck (1989) reported there were 19 gillnetters active in 1986, 28 active in 1987, and 21 in 1988.

More recently, an observer program implemented in the summer of 1993 provided a total by-catch estimate of 424 harbor porpoises (± 1 SE: 200-648) from 62 observed trips, which is an 11.3% coverage of the Bay of Fundy trips (Trippel *et al.* 1996). This estimate is not considered to be as accurate as more recent estimates because of low observer coverage and the absence of temporal stratification (Trippel *et al.* 1996).

During 1994, the observer program was expanded to cover 49.4% of the gillnet trips (171 observed trips). The by-catch was estimated to be 101 harbor porpoises (95% confidence limit: 80-122), where the fishing fleet consisted of 28 vessels (Trippel *et al.* 1996).

During 1995, due to groundfish quotas being exceeded, the gillnet fishery was closed during July 21 to August 31, 1995. During the open fishing period of 1995, 89% of the fishing trips were observed, all in the Swallowtail region. Approximately 30% of these observed trips used pingered nets. The estimated by-catch was 87 harbor porpoises (Trippel *et al.* 1996). No confidence interval was able to be computed due to lack of coverage in the Wolves fishing grounds.

During 1996, the Canadian gillnet fishery was closed from July 20-31 and August 16-31 due to reduced groundfish quotas. From the 107 monitored trips, the by-catch from 1996 was estimated to be 20 harbor porpoises (Trippel *et al.* 1999; DFO 1998).

During 1997, the fishery was closed to the majority of the gillnet fleet from July 18-31 and August 16-31, due to reduced groundfish quotas. In addition a time-area closure to reduce porpoise by-catch in the Swallowtail area occurred during September 1-7, 1997. From the 75 monitored trips during 1997, 19 harbor porpoises were observed taken. After accounting for total fishing effort, the estimated by-catch in 1997 was 43 animals (DFO 1998).

During 1998, the number of fishing vessels was appreciably lower than in previous years due to very poor groundfish catch rates, even though the fishery was open throughout July to September. Seventeen trips were monitored and one harbor porpoise mortality was observed. Fishers independently reported an additional four porpoises. The Wolves and Head Harbour area had seven fishing trips in July and did not receive coverage. A preliminary total by-catch for Bay of Fundy in 1998 was estimated at 10 porpoises. No estimates of variability are available (DFO 1998).

Average estimated harbor porpoise mortality in the Canadian groundfish sink gillnet fishery during 1993-1997 was 135 (Table 2). No estimate of variability is possible.

Herring Weirs

Harbor porpoises takes have been observed in Canadian fishing weirs, though not in USA fishing weirs. However, no program has been set up to observer USA fishing weirs. In the Bay of Fundy, weirs are operating 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). According to state of Maine officials, in 1998, the number of weirs in Maine waters has dropped to nearly zero due to the limited herring market (Jean

Chenoweth pers. comm.). According to Canadian DFO officials, for 1998, there were 225 licenses for herring weirs on the New Brunswick side and 30 from the Nova Scotia side of the Bay of Fundy (In New Brunswick: 60 from Grand Manan Island, 95 from Deer and Campobello Islands, 30 from Passamaquoddy Bay, 35 from East Charlotte area, and 5 from the Saint John area). This number has been fairly consistent since 1985 (Ed Trippel, pers. comm.) The actual number of active weirs in the USA is not known.

Smith *et al*. (1983) estimated approximately 70 harbor porpoises become trapped annually and, on average, 27 died annually, and the rest were 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). Due to the cooperative program, out of 263 documented harbor porpoises caught in herring weirs during 1992 to 1994, 57 died while the rest were either released or escaped. The numbers that died during the seining process (and were released alive) were 11 (and 50) in 1992, 33 (and 113) in 1993, and 13 (and 43) in 1994 (Neimanis *et al*. 1995). Out of 125 documented harbor porpoises caught in herring weirs during 1995 to 1998, 11 died while the rest were either released or escaped. The numbers that died (and were released alive or escaped) were 5 (and 60) in 1995; 2 (and 4) in 1996; 2 (and 24) in 1997; and 2 (and 26) in 1998 (Westgate, per. comm.).

Average estimated harbor porpoise mortality in the Canadian herring weir fishery during 1993-1997 was 11 (Table 2). No estimate of variance is possible.

Table 2. Summary of the incidental mortality of harbor porpoise (*Phocoena phocoena*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
USA								
New England Multispecies Sink Gillnet	93-97	1993=349	Obs. Data Weighout, Trip Logbook	.05, .07, .05, .04, .06	53[3],99[3], 43[3],52[3], 47[3]	1400[3],2100[3],1400[3],1200[3],775[3]	.18, .18, .27, .25, .24	1375 (.10)
Mid-Atlantic Coastal Sink Gillnet	95-97[6]	Unk[7]	Obs. Data Weighout	.05, .04, .03	6, 19, 32	103, 311, 572	.57, .31, .35	329 (0.23)
Pelagic Drift Gillnet	93-97	1994=11[4] 1995=12 1996=10 1997=NA[8]	Obs. Data Logbook	.42, .87, .99, .64, NA[8]	1,0, 0, 0, NA[8]	1.5[5], 0, 0, 0, NA[8]	.34, 0, 0, 0, NA[8]	0.4[8] (.34)
USA TOTAL								1704 (0.09)
CANADA								
Groundfish Sink Gillnet	93-98	1994=28	Obs. Data Can. Trips	.11,.49,.89, .8,.8,.8	25,49,25, 13,19,1	424,101,87,20,43,10	NA	135[9] (NA)
Herring Weir	93-98	1998=255 licenses[10]	Coop. Data	NA	33,13,5, 2,2,2	33,13,5, 2,2,2	NA	11[9] (NA)
CANADIAN TOTAL								146 (NA)
TOTAL								1850 (NA)

NA = Not available.

1 Observer data (Obs. Data) are used to measure by-catch rates; the USA data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program, the Canadian data are collected by DFO. NEFSC collects Weighout (Weighout) landings data, and total landings are used as a measure of total effort for the USA sink gillnet fisheries. The Canadian DFO catch and effort statistical system collected the total number of trips fished by the Canadians (Can. trips), which was the measure of total effort for the Canadian groundfish gillnet fishery. Mandatory trip logbook (Trip Logbook) data are used to determine the spatial distribution of some fishing effort in the New England multispecies sink gillnet fishery. Mandatory logbook (Logbook) data are used to measure total effort for the pelagic drift gillnet fishery, and these data are collected at the Southeast Fisheries Science Center (SEFSC). Observed mortalities from herring weirs are collected by a cooperative program between fishermen and Canadian biologists (Coop. Data).

[2] The observer coverage for the USA and Canadian sink gillnet fishery is measured in trips, for the pelagic drift gillnet fishery the unit of effort is a set, and for the Mid-Atlantic coastal sink gillnet fishery the unit of effort is tons of fish landed.
[3] Harbor porpoise taken during and before 1997 in observed pinger trips were added directly to the estimated total by-catch for that year. There were 10, 33, 44, 0, 11, and 8 observed harbor porpoise takes on pinger trips from 1992 to 1997, respectively. In addition, there were 9 and 2 observed harbor porpoise takes in 1995 and 1997, respectively on trips dedicated to fish sampling versus marine mammals (Bisack 1997a).
[4] 1994, 1995, and 1996 shown, other years not available on an annual basis.
[5] For 1991-1993, pooled by-catch rates were used to estimate by-catch in months that had fishing effort but did not have observer coverage (Northridge 1996). After 1993, observer coverage increased substantially, and by-catch rates were annual rates (Bisack 1997b). The fishery was closed during 1997.
[6] Only data after 1994 are reported because the observed coverages during 1993 and 1994 were negligible during the times of the year when harbor porpoise takes were possible.
[7] The number of vessels in the Mid-Atlantic coastal sink gillnet fishery is presently not available.
[8] Fishery closed during 1997. So average by-catch is from 1993 to 1996.
[9] To be consistent with years in USA calculations, average is calculated from 1993 to 1997 estimates.
[10] There were 255 licenses for herring weirs in the Canadian Bay of Fundy region.

Other Mortality

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 1980's, small kills by native hunters (Passamaquoddy Indians) were reported. In recent years it was believed to have nearly stopped (Polacheck 1989) until recent public media reports in September 1997 depicted a Passamoquoddy tribe member dressing out a harbor porpoise. Further articles describing use of porpoise products for food and other purposes were timed to coincide with ongoing legal action in state court.

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 USA 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 1994 and 1996, 107 harbor porpoise carcasses were recovered from beaches in Maryland, Virginia, and North Carolina. Only juvenile harbor porpoises were present in this sample. Of the 40 harbor porpoises for which cause of death could be established, 25 displayed definitive evidence of entanglement in fishing gear. In four cases it was possible to determine that the animal was entangled in monofilament nets (Cox *et al.* 1998).

During 1996 and 1997, the NE Regional Office/NMFS strandings and entanglement database recorded 211 harbor porpoises that stranded on beaches from North Carolina to Maine (Table 3). Of these, three stranded alive on a Massachusetts beach and were tagged and subsequently released. The largest number of recorded strandings were on Massachusetts beaches. The states with the next largest numbers were North Carolina, New Jersey and Virginia, in that order. The number of these strandings that show signs of human interactions is presently being investigated.

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.

Table 3. Summary of number of stranded harbor porpoises during January 1, 1996 to December 31, 1997, by state and year.

State	Year		Total
	1996	1997	
Maine	5	6	11
New Hampshire	2	0	2
Massachusetts[1]	28	28	56
Rhode Island	1	1	2
Connecticut	1	0	1
New York	3	10	13
New Jersey	12	21	33
Delaware	4	3	7
Maryland	3	10	13
Virginia	20	12	32
North Carolina	12	26	38
TOTAL	91	117	208

[1] During 1996, an additional three animals stranded alive on a Massachusetts beach. They were tagged and released.

STATUS OF STOCK

The status of harbor porpoises, relative to OSP, in the USA Atlantic EEZ is unknown. On January 7, 1993, the National Marine Fisheries Service (NMFS) proposed listing the Gulf of Maine harbor porpoise as threatened under the Endangered Species Act (NMFS 1993). On January 5, 1999, the NMFS determined the proposed listing was not warranted (NMFS 1999). There are insufficient data to determine population trends for this species. 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 is a strategic stock because average annual fishery-related mortality and serious injury exceeds PBR.

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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; Gilbert and Guldager 1998). Although the stock structure of the western North Atlantic population is unknown, it is thought that harbor seals found along the eastern USA and Canadian coasts represent one population (Temte et al. 1991). Breeding and pupping normally occurs in waters north of the New Hampshire/Maine border, although breeding occurred as far south as Cape Cod in the early part of the twentieth century (Temte et al. 1991; Katona et al. 1993).

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 Florida (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 (Richardson 1976; Wilson 1978; Whitman and Payne 1990; Kenney 1994). 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. Coast-wide aerial surveys along the Maine coast have been conducted in May/June during pupping in 1981, 1982, 1986, 1993, and 1997 (Table 1; Gilbert and Stein 1981; Gilbert and Wynne 1983, 1984; Kenney 1994; and Gilbert and Guldager 1998). These numbers are considered to be a minimum abundance estimate because they are 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; Rough 1995). 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.

Table 1. Summary of abundance estimates for the western Atlantic harbor seal. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{min}) and coefficient of variation (CV).

Month/Year	Area	N_{min}	CV
May/June 1981	Maine coast	10,540 (676)[1]	None reported
May/June 1982	Maine coast	9,331 (1,198)	None reported
May/June 1986	Maine coast	12,940 (1,713)	None reported
May/June 1993	Maine coast	28,810 (4,250)	None reported
May/June 1997	Maine coast	30,990 (5,359)	None reported
August 1992	Bay of Fundy	3,600	None reported

[1]Pup counts are in brackets

Minimum Population Estimate

A minimum population estimate is 30,990 seals, based on uncorrected total counts along the Maine coast in 1997.

Current Population Trend

The annual increase since 1993 has been 1.8 % (Gilbert and Guldager 1998). Since 1981, the average increase has been 4.2 % (Gilbert and Gualdager 1998), about 50% of the 8.9 percent annual increase estimated Kenney (1994) from counts through 1993. Similarly, the number of pups along the Maine coast has increased at an annual rate of 12.9% over the 1981-1997 period (Gilbert and Guldager 1998). 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 unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a “recovery” factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 30,990. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor (F_R) for this stock is 1.0, the value for stocks of unknown status, but known to be increasing. PBR for counts in USA waters is 1,859.

ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality or serious injury to this stock during 1993-1997 was 943 harbor seals (CV = 0.11; Table 2).

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 USA 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).

Fishery Information

USA

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

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.

New England Multispecies Sink Gillnet:

In 1993, there were approximately 349 full and part-time vessels in the New England multispecies sink gillnet fishery, which covered the Gulf of Maine and southern New England (Table 2). 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 1996) and their fishing effort was not used in estimating mortality. Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%, 4%, and 6% for 1990 to 1997, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. There were 272 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 1997. Annual estimates of harbor seal by-catch in the New England multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Estimated annual mortalities (CV in parentheses) from this fishery during 1990-1997 was 602 in 1990 (0.68), 231 in 1991 (0.22), 373 in 1992 (0.23), 698 in 1993 (0.19), 1,330 in 1994 (0.25), 1,179 in 1995 (0.21), 911 in 1996 (0.27), and 598 in 1997 (0.26). The 1994 and 1995 by-catches, respectively, include 14 and 179 animals from the estimated number of unknown seals (based on observed mortalities of seals that could not be identified to species). The unknown seals were prorated, based on spatial/temporal patterns of by-catch of harbor seals, gray seals, harp seals, and hooded seals. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1993-1997 was 943 harbor seals (CV = 0.11). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). 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.

CANADA

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.

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).

In 1996, observers recorded seven harbor seals (one released alive) in Spanish deep water trawl fishing on the southern edge of the Grand Bank (NAFO Areas 3) (Lens, 1997). Seal by-catches occurred year-round, but interactions were highest during April-June. Many of the seals that died during fishing activities were unidentified. The proportion of sets with mortality (all seals) was 2.7 per 1,000 hauls (0.003).

Table 2. Summary of the incidental mortality of harbor seal (*Phoca vitulina*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality[3]	Estimated Mortality[3]	Estimated CVs	Mean Annual Mortality
New England Multispecies Sink Gillnet	93-97	349	Obs. Data Weighout, Logbooks	.05, .07, .05, .04, .06	22, 86, 56,36, 48	698, 1330, 1179, 911, 598	.19, .25, .21, .27, .26	943 (.11)
TOTAL								943 (.11)

1 Observer data (Obs. Data) are used to measure by-catch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects Weighout (Weighout) landings data, and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of some fishing effort in the New England multispecies sink gillnet fishery.

2 The observer coverage for the New England multispecies sink gillnet fishery is measured in trips.

3 In 1994, 1995, 1996, and 1997 respectively, observed mortality on "marine mammal trips" was 59, 41, 37, and 14 animals. Only these mortalities were used to estimate total harbor seal by-catch. In 1994, 3 mortalities were observed on "fish trips" and 24 on "pinger trips." In 1995, 15 mortalities were recorded on "fish trips". In 1996 two mortalities were recorded on "pinger trips" and three on "fish trips". In 1997, one animal was taken on a "fish trip," and 14 harbor seals were taken on pingered trips. See Bisack (1997) for "trip" type definitions.

Other Mortality

Annually, small numbers of harbor seals regularly strand throughout their migratory range. Most stranding, however, occur 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, power plant intake (12-20 per year; NMFS unpubl. Data), oil, shooting), storms, abandonment by the mother, and disease (Katona *et al*. 1993; NMFS unpublished data). Interactions with Maine salmon aquaculture operations appears to be increasing, although the magnitude of interactions and seal mortalities has not been quantified (Anon 1996). In 1980, more than 350 seals were found dead in the Cape Cod area from an influenza outbreak (Geraci *et al*. 1981).

The 1992-1996 harbor seal strandings data are currently under review. In 1995 one stranding was in South Carolina. In 1997, there were 153 stranding , including one each was in Georgia and Florida. The majority of the strandings were in New England, Maine (71/153) and Massachusetts (32/153). In the mid-Atlantic region, most of the stranding events occurred in New York (17/153) and New Jersey (11/153). Eighteen animals showed signs of human interactions: fishery (4), vessel strike (2), power plant (8), and other (4).

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.

STATUS OF STOCK

The status of harbor seals, relative to OSP, in the USA Atlantic EEZ is unknown, but the population is increasing. The species is not listed as threatened or endangered under the Endangered Species Act. Gilbert and Guldager (1998) estimated a 4.4% annual rate of increase of this stock in Maine coastal waters based on 1981, 1982, 1986, 1993, 1997 surveys conducted along the Maine coast. The population is increasing despite the known fishery-related mortality. 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 approaching zero mortality and serious injury rate. This is not a strategic stock because fishery-related mortality and serious injury does not exceed PBR.

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GRAY SEAL (*Halichoerus grypus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray seal is found in the western North Atlantic from New England to Labrador and is centered in the Sable Island region of Nova Scotia (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, pers. comm., University of Maine, Orono, ME). In recent years, a year-round breeding population of approximately 400 animals has been documented on the outer Cape Cod and Nantucket Island (Dennis Murley, pers. comm., Mass. Audubon Society, Wellfleet, MA). Gilbert (pers. comm) has also documented a resident colony in Maine.

POPULATION SIZE

Estimates of the total western Atlantic gray seal population are not available; however, four estimates of portions of the stock are available for Sable Island, the Maine coast, and Muskeget Island (Nantucket) and Monomoy, (Cape Cod) Massachusetts (Table 1). The 1986 population estimate for individuals on Sable Island, Nova Scotia that are one year old and older was between 100,000 and 130,000 animals (Stobo and Zwanenburg 1990). The 1993 estimate of the Sable Island and Gulf of St. Lawrence stocks was 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; recently 29-49 pups/year have been recorded in Penobscot Bay (J. R. Gilbert, pers. comm.). Maximum counts of individuals at a winter breeding colony on Muskeget Island, west of Nantucket Island 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 2,010 gray seals for Muskeget Island and Monomoy combined (Rough 1995).

Table 1. Summary of abundance estimates for the western North Atlantic gray seal. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{min}) and coefficient of variation (CV).

Month/Year	Area	N_{min}	CV
1986	Sable Island	100,000 to 130,000	none reported
1993	Sable Island and Gulf of St. Lawrence	143,000	none reported
1993	Maine coast	500-1000	none reported
Apr-May 1994	Muskeget Island and Monomoy, MA (only US portion of stock)	2,010	none reported

Minimum Population Estimate

At the November 1998 meeting of the Atlantic Scientific Review Group (SRG), the SRG recommended that the minimum estimate (2,010) used in previous assessments be discontinued, because it did not account for the unknown fraction of the Sable Island gray seal stock that overwinters in the Nantucket Sound region. Therefore, present data are insufficient to calculate the minimum population estimate for USA waters. It is estimated that there are at least 143,000 gray seals in Canada (Mohn and Bowen 1993).

Current Population Trend

Gray seal abundance is likely increasing in the USA Atlantic Exclusive Economic Zone (EEZ), but the percent increase is unknown. The population has been increasing for several decades in Canadian waters.

Pup production on Sable Island, Nova Scotia, has been about 13% per year since 1962 (Mohn and Bowen 1994). Approximately 57% of the western North Atlantic population is from the Sable Island stock.

Winter breeding colonies in Maine and on Muskeget 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 (Rough 1995).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. One study that estimated pup production on Sable Island estimated the annual production rate was 13% (Mohn and Bowen 1994).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor (F_R) for this stock is 1.0, the value for stocks of unknown status, but known to be increasing. PBR for the western North Atlantic gray seals in USA waters is unknown. Applying the formula to the minimum population estimate for Canadian waters results in a "PBR" of 8,850 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 USA waters (Rough 1995).

Total annual estimated average fishery-related mortality or serious injury to this stock during 1993- 1997 was 67 gray seals (CV = 0.27; Table 2).

Fishery Information

USA

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

New England Multispecies Sink Gillnet:

In 1993, there were approximately 349 full and part-time vessels in the New England multispecies sink gillnet fishery, which covered the Gulf of Maine and southern New England (Table 2). 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 1996) and their fishing effort was not used in estimating mortality. Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%, 4%, and 6% for 1990 to 1997, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. There were 31 gray seal mortalities observed in the New England multispecies sink gillnet fishery between 1993-1997 (Table 2). Nineteen of the observed mortalities occurred in winter (January - May), 7 in the southern Gulf of Maine and one in the "mid-coast closed area." Only one mortality was observed in northern Maine waters, which occurred in autumn (September-December) 1995. One of the 1993 observed mortalities was in May, and was from SE of Block Island. In addition, V. Rough (pers. comm.) 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).

Annual estimates of gray seal by-catch in the New England multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Estimated annual mortalities (CV in parentheses) from this fishery during 1990-1996 was zero in 1990-1992, 18 in 1993 (1.00), 19 in 1994 (0.95), 117 in 1995 (0.42), 49 in 1996 (0.49), and 131 in 1997 (0.50). The 1995 by-catch includes 28 animals from the estimated number of unknown seals (based on observed mortalities of seals that could not be identified to species). The unknown seals were prorated, based on spatial/temporal patterns of by-catch of harbor seals, gray seals, harp seals, and hooded seals. Further, they will likely have little impact on the estimates presented. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1993-1997 was 67 gray seals (CV = 0.27). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996).

CANADA

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).

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).

In 1996, observers recorded three gray seals (one released alive) in Spanish deep water trawl fishing on the southern edge of the Grand Bank (NAFO Areas 3) (Lens, 1997). Seal by-catches occurred year-round, but interactions were highest during April-June. Many of the seals that died during fishing activities were unidentified. The proportion of sets with mortality (all seals) was 2.7 per 1,000 hauls (0.003).

Table 2. Summary of the incidental mortality of gray seal (*Halichoerus grypus*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality[3]	Estimated Mortality[3]	Estimated CVs	Mean Annual Mortality
New England Multispecies Sink Gillnet	93-97	349	Obs. Data Weighout, Logbooks	.05, .07, .05, .04, .06	2, 3, 7, 3, 16	18, 19, 117, 49, 131	1.00, .95, .42, .49, .50	67 (.27)
TOTAL								67 (.27)

1 Observer data (Obs. Data) are used to measure by-catch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects Weighout (Weighout) landings data, and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of some fishing effort in the New England multispecies sink gillnet fishery.

2 The observer coverage for the New England multispecies sink gillnet fishery is measured in trips.

3 In 1994 and 1995, respectively, observed mortality on "marine mammal trips" was 2 and 6 animals. Only these mortalities were used to estimate total gray seal by-catch. In 1994 and 1995, one mortality in each year was recorded on a "fish trip." See Bisack (1997) for "trip" type definitions. In 1997 all observed takes were on marine mammal trips, including 12 taken on pingered trips.

Other Mortality

The 1992-1996 gray seal strandings data are currently under review. Forty-two stranding were recorded in 1997, extending from Maine (11) to Maryland (1). Most of the strandings were in Maine (11) and Massachusetts (12). Two animals showed signs of human interactions, including one that was shot. 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 wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction.

STATUS OF STOCK

The status of the gray seal population, relative to OSP, in USA Atlantic EEZ waters is unknown, but the populations appear to be increasing in Canadian and USA waters. The species is not listed as threatened or endangered under the Endangered Species

Act. Recent data indicate that this population is increasing. 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. The level of human-caused mortality and serious injury in the USA Atlantic EEZ is unknown, but believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

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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; Stevick and Fernald 1998; B. Rubinstein pers. comm., New England Aquarium). These appearances usually occur in January-May, when the western North Atlantic stock of harp seals is at its southern most 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 (Sergeant 1965; 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; Anon 1998).

Harp seals are highly migratory (Sergeant 1965; Stenson and Sjare 1997). 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 molt. The migration then continues north to Arctic summer feeding grounds. In late September, after a summer of feeding, nearly all adults and some of the immature animals migrate southward along the Labrador coast, usually reaching the entrance to the Gulf of St. Lawrence by early winter. There they split into two groups, one moving into the Gulf and the other remaining off the coast of Newfoundland. Following mating, the seals disperse to feed, and in late April they again concentrate in large numbers on the ice to molt.

The extreme southern limit of the harp seal's habitat extends into the USA Atlantic Exclusive Economic Zone (EEZ) during winter and spring. The influx of harp seals and geographic distribution in New England to mid-Atlantic waters is based primarily on strandings, and secondarily on fishery bycatch (McAlpine and Walker 1990; Rubinstein 1994).

POPULATION SIZE

The total population size of harp seals is unknown; however, three seasonal abundance estimates are available which used a variety of methods including aerial surveys and mark-recapture (Table 1). Generally, these methods include surveying the whelping concentrations and 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 1983; 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 (Table 1).

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) (Table 1). Using a revised population model, 1994 pup count data, and two assumptions regarding pup mortality rates; Shelton *et al*. (1996) estimated pup production and total population size for the period 1955-1994. The 1994 total population estimates were 4.5-4.8 million harp seals (Table1).

Table 1. Summary of abundance estimates (pups and total) for western North Atlantic harp seals. Year and area covered during each abundance survey, and resulting abundance estimate (N_{min}) and coefficient of variation (CV).

Month/Year	Area	N_{min}	CV
1990	Eastern Atlantic Canada-Labrador	577,900 pups	none reported
1994	Eastern Atlantic Canada-Labrador	702,900 pups	0.09
1990	Eastern Atlantic Canada-Labrador	3 million	none reported
1990	Eastern Atlantic Canada-Labrador	3.1 million	none reported
1994	Eastern Atlantic Canada-Labrador	4.5-4.8 million	none reported

Minimum population estimate

Present data are insufficient to calculate the minimum population estimate for USA waters. It is estimated there are at least 4.8 million harp seals in Canada (Shelton *et al.* 1996).

Current population trend

The population appears to be increasing in USA waters, judging from the increased number of stranded harp seals, but the magnitude of the suspected increase is unknown. In Canada, since 1990 the average annual growth rate has been estimated to be about 5% (Shelton *et al.* 1996).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The best 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 *et al.* 1996). The mean age of sexual maturity was 5.8 yrs in the mid-1950's, declining to 4.6 yrs in the early 1980's and then increasing to 5.4 yrs in the early 1990's (Sjare *et al.* 1996).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) was set at 1.0 because it was believed that harp seals are within OSP. PBR for the western North Atlantic harp seal in USA waters is unknown. Applying the formula to the minimum population estimate for Canadian waters results in a "PBR" of 288,000 harp seals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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 186,000 seals, and remained at this level through 1995 (Stenson 1993; Anon 1998). The TAC was increased to 250,000 and 275,000, respectively in 1996 and 1997 (Anon 1998). Catches ranged from 124,000 to 231,000 from 1971-1982, declining to a range of 19,000 to 94,000 between 1983-1995, and increased dramatically to 242,000 (1996) and 261,000 (1997) (Stenson 1993; Anon 1998). The commercial catches do not account for subsistence takes.

Total annual estimated average fishery-related mortality or serious injury to this stock during 1993-1997 was 383 harp seals (CV = 0.29; Table 2).

Fishery Information

USA

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

Recent by-catch has been observed by NMFS Sea Samplers in the New England multispecies sink gillnet fisheries, but no mortalities have been documented in the Mid-Atlantic coastal gillnet, Atlantic drift gillnet, pelagic pair trawl or pelagic longline fisheries.

In 1993, there were approximately 349 full and part-time vessels in the New England multispecies sink gillnet fishery, which covered the Gulf of Maine and southern New England (Table 2). 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 1996) and their fishing effort was not used in estimating mortality. Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%,4%, and 6% for 1990 to 1997, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. There were 69 harp seal mortalities observed in the New England multispecies sink gillnet fishery between 1990 and 1996. Annual estimates of harp seal by-catch in the New England multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Estimated annual mortalities (CV in parentheses) from this fishery during 1990-1996 was zero (1990-1993), 861 in 1994 (0.58), 694 in 1995 (0.27), 89 in 1996 (0.55), and 269 in 1997 (0.50). The 1994 and 1995 by-catches, respectively, include 16 and 153 animals from the estimated number of unknown seals (based on observed mortalities of seals that could not be identified to species). The unknown seals were prorated, based on spatial/temporal patterns of by-catch of harbor seals, gray seals, harp seals, and hooded seals. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1993-1997 was 383 harp seals (CV = 0.29). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). The by-catch occurred principally in winter (January-May) and was mainly in waters between Cape Ann and New Hampshire. One observed winter mortality was in waters south of Cape Cod.

CANADA

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).

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.

In 1996, observers recorded four harp seals (one released alive) in Spanish deep water trawl fishing on the southern edge of the Grand Bank (NAFO Areas 3) (Lens, 1997). Seal by-catches occurred year-round, but interactions were highest during April-June. Many of the seals that died during fishing activities were unidentified. The proportion of sets with mortality (all seals) was 2.7 per 1,000 hauls (0.003).

Table 2. Summary of the incidental mortality of harp seal (*Phoca groenlandica*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality[3]	Estimated Mortality	Estimated CVs	Mean Annual Mortality
New England Multispecies Sink Gillnet	93-97	349	Obs. Data Weighout, Logbooks	.05, .07, .05, .04, .06	0, 33, 27, 9, 40	0, 861, 694, 89, 269	0, .58, .27, .55, .50	383 (.29)
TOTAL								383 (.29)

1 Observer data (Obs. Data) are used to measure by-catch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects Weighout (Weighout) landings data, and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of some fishing effort in the New England multispecies sink gillnet fishery.

2 The observer coverage for the New England multispecies sink gillnet fishery is measured in trips.

3 In 1997 thirty-one harp seals were taken on pingered trips, all observed mortality was on "mammal trips." See Bisack (1997) for “trip” type definitions.

Other Mortality

From 1988-1993 strandings each year were under 50, approaching 100 animals in 1994, and exceeding 100 animals in 1995-1996 (Rubinstein 1994; B. Rubinstein, New England Aquarium, pers. comm.). In addition, in 1996 there was a stranding in North Carolina. In 1997, 119 strandings were recorded, including one in North Carolina. The majority of the stranding occurred in Maine (17), Massachusetts (28), and New York (48). The increased number of strandings may indicate a possible shift in distribution or expansion southward into USA waters; if so, fishery interactions may increase.

STATUS OF STOCK

The status of the harp seal stock, relative to OSP, in the USA Atlantic 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. 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. The level of human-caused mortality and serious injury in the USA Atlantic EEZ is unknown, but believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

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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; Stenson *et al.* 1996). 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 southern most 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). In the northwest Atlantic, whelping occurs in the Davis Strait, off Newfoundland and in Gulf of St. Lawrence (Stenson *et al.* 1996). One stock, which whelps off the coast of eastern Canada, is divided into two breeding herds (Front and Gulf) which breed on the pack ice. The Front herd (largest) breeds off the coast of Newfoundland and Labrador and the Gulf herd breeds in the Gulf of St. Lawrence. The second stock breeds in the Davis Strait, and the third stock occurs on the West Ice off eastern Greenland.

Hooded seals are a highly migratory species. Hooded seals remain on the Newfoundland continental shelf during winter/spring (Stenson *et al.* 1996). Breeding occurs at about the same time in March for each stock. Adults from all stocks then assemble in the Denmark Strait to molt between late June and August (King 1983; Anon 1995), 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 USA 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 influx of harp seals and geographic distribution in New England to mid-Atlantic waters is based on stranding data.

POPULATION SIZE

The number of hooded seals in the western North Atlantic is unknown. Seasonal abundance estimates are available based on a variety of analytical methods based on commercial catch data, and including aerial surveys. These methods often include surveying the whelping concentrations and modeling the pup production. Several estimates of pup production at the Front are available. Hooded seal pup production between 1966 and 1977 was estimated between 25,000 - 32,000 annually (Benjaminsen and Oritsland 1975; Sergeant 1976; Lett 1977; Winters and Bergflodt 1978; Stenson *et al.* 1996). Estimated pup production dropped to 26,000 hooded seal pups in 1978 (Winters and Bergflodt 1978). Pup production estimates began to increase after 1978, reaching 62,000 (95% CI. 43,700 - 89,400) by 1984 (Bowen *et al.* 1987). Bowen *et al.* (1987) also estimated pup production in the Davis Strait at 18,600 (95% C.I. 14,000 - 23,000). A 1985 survey at the Front (Hay*et al.* 1985) produced a estimate of 61,400 (95% C.I. 16,500 - 119,450). Hammill *et al.* (1992) estimated pup production to be 82,000 (SE=12,636) in 1990. 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). Based on the 1990 survey, Stenson *et al.* (1995) suggests that pup production may have increased at about 5% per year since 1984. However, because of exchange between the Front and the Davis Strait stocks, the possibility of a stable or slightly declining level of pup production are also likely (Stenson 1993; Stenson *et al.* 1996). It appears that the number of hooded seals is increasing.

Table 1. Summary of pup production estimates for western North Atlantic hooded seals. Year and area covered during each abundance survey, and resulting abundance estimate (N_{min}) and coefficient of variation (CV).

Month/Year	Area	N_{min}	CV
1978	Front herd: Newfoundland/ Labrador	26,000	none reported
1984	Front herd: Newfoundland/Labrador	62,000	none reported
1984	Davis Strait	18,600	none reported
1985	Front herd: Newfoundland/Labrador	61,400	none reported
1990	Front herd: Newfoundland/Labrador	82,100	none reported

Minimum population estimate

Present data are insufficient to calculate the minimum population estimate for USA waters. It is estimated that there are approximately 400,000 hooded seals (5:1 ratio of adults to pups) in Canadian waters (Stenson *et al.* 1993).

Current population trend

The population appears to be increasing in USA 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

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

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) was set at 1.0 because it was believed that harp seals are within OSP. PBR for the western North Atlantic hooded seal in USA waters is unknown. Applying the formula to abundance estimates (400,000) in Canadian waters results in a PBR= 24,000 hooded seals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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 (Stenson 1993; Anon 1998). From 1991- 1992 the TAC was increased to 15,000. A TAC of 8,000 was set for 1993, and held at that level through 1997. From 1974 through 1982, the average catch was 12,800 animals, mainly pups. Since 1983 catches ranged from 33 in 1986 to 6,425 in 1991, with a mean catch of 1,001 between 1983 and 1995. In 1996 catches (25,754) were more than three times the allowable quota (Anon 1998). The high catch was attributable to good ice conditions and strong market demand. Catches in 1997 were 7,058, slightly below the TAC.

Hunting in the Gulf of St. Lawrence (below 50^0N) has been prohibited since 1964. No commercial hunting of hooded seals is permitted in the Davis Strait.

Total annual estimated average fishery-related mortality or serious injury to this stock in USA waters during 1993-1997 was 5.6 hooded seals (CV = 0.96; Table 2).

Fishery Information

USA

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

Recent by-catch has been observed by NMFS Sea Samplers in the New England multispecies sink gillnet fisheries, but no mortalities have been documented in the Mid-Atlantic coastal gillnet, Atlantic drift gillnet, pelagic pair trawl or pelagic longline fisheries.

In 1993, there were approximately 349 full and part-time vessels in the New England multispecies sink gillnet fishery, which covered the Gulf of Maine and southern New England (Table 2). 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 1996) and their fishing effort was not used in estimating mortality. Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%,4%, and 6% for 1990 to 1997, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. There was one hooded seal mortality observed in the New England multispecies sink gillnet fishery between 1990 and 1996. Annual estimates of hooded seal by-catch in the New England multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Estimated annual mortalities (CV in parentheses) from this fishery during 1990-1996 was zero (1990-1994), and 28 in 1995 (0.96), and zero in 1996-1997. The 1995 by-catch includes five animals from the estimated number of unknown seals (based on observed mortalities of seals that could not be identified to species). The unknown seals were prorated, based on spatial/temporal patterns of by-catch of harbor seals, gray seals, harp seals, and hooded seals. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1993-1997 was 5.6 hooded seals (CV = 0.96). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). The by-catch occurred only in winter (January-May) and was in waters between Cape Ann and New Hampshire.

CANADA

An unknown number of hooded seals have been taken in Newfoundland and Labrador groundfish gillnets (Read 1994).

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.

Table 2. Summary of the incidental mortality of hooded seal (*Cystophora cristata*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
New England Multispecies Sink Gillnet	93-97	349	Obs. Data Weighout, Logbooks	.05, .07, .05, .04, .06	0, 0, 1, 0, 0	0, 0, 28, 0, 0	0, 0, .96, 0, 0	5.6 (.96)
TOTAL								5.6 (.96)

1 Observer data (Obs. Data) are used to measure by-catch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects Weighout (Weighout) landings data, and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of some fishing effort in the New England multispecies sink gillnet fishery.

2 The observer coverage for the New England multispecies sink gillnet fishery is measured in trips.

Other Mortality

In 1988-93, strandings were less than 20 per year, and from 1994- 1997 they increased to about 50 per annum (Rubinstein 1994; B. Rubinstein, New England Aquarium, pers. comm; NMFS unpublished data). Carcasses were recovered from Massachusetts, Connecticut, and New York (Rubinstein 1994), North Carolina and U.S. Virgin Islands (NMFS, unpublished data). The increased number of strandings may indicate a possible shift in distribution or range expansion southward into USA waters and, if so, fishery interactions may increase.

STATUS OF STOCK

The status of hooded seals relative to OSP in USA Atlantic EEZ is unknown. They are not listed as threatened or endangered under the Endangered Species Act. 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 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.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Gulf of Mexico Bay, Sound, and Estuarine Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed throughout the bays, sounds, and estuaries of the Gulf of Mexico (Mullin 1988). The identification of biologically-meaningful "stocks" of bottlenose dolphins in these waters is complicated by the high degree of behavioral variability exhibited by this species (Shane *et al.* 1986; Wells and Scott 1999), and by the lack of requisite information for much of the region.

Previous stock assessment reports have provisionally identified distinct stocks in each of 33 areas of contiguous, enclosed, or semi-enclosed bodies of water adjacent to the Gulf of Mexico (Table 1, Waring *et al.* 1997), based on descriptions of relatively discrete dolphin "communities" in some of these areas. A "community" includes resident dolphins that regularly share large portions of their ranges, exhibit similar distinct genetic profiles, and interact with each other to a much greater extent than with dolphins in adjacent waters. The term, as adapted from Wells *et al.* (1987), emphasizes geographic, genetic, and social relationships of dolphins. Bottlenose dolphin communities do not constitute closed demographic populations, as individuals from adjacent communities are known to interbreed. Nevertheless, the geographic nature of these areas and long-term stability of residency patterns suggest that many of these communities exist as functioning units of their ecosystems and, under the Marine Mammal Protection Act, must be maintained as such. Also, the stable patterns of residency observed within communities suggest that long periods would be required to repopulate the home range of a community were it eradicated or severely depleted. Thus, in the absence of information supporting management on a larger scale, it is appropriate to adopt a risk-averse approach and focus management efforts at the level of the community rather than at some larger demographic scale. Support for this risk-averse approach derives from several sources.

Long-term (year-round, multi-year) residency by at least some individuals has been reported from nearly every site where photographic identification or tagging studies have been conducted in the Gulf of Mexico. In Texas, some of the dolphins in the Matagorda-Espiritu Santo Bay area (Gruber 1981; Lynn 1995; Würsig and Lynn 1996), Aransas Pass (Shane 1977; Weller 1998), San Luis Pass (Maze 1997), and Galveston Bay (Bräger 1993; Bräger *et al.* 1994; Fertl 1994) have been reported as long-term residents. Hubard (1998) reported sightings of dolphins tagged 12-15 years previously in Mississippi Sound. In Florida, long-term residency has been reported from Choctawhatchee Bay (1989-1993, F. Townsend, unpublished data), Tampa Bay (Wells 1986; Wells *et al.* 1996a), Sarasota Bay (Irvine and Wells 1972; Irvine *et al.* 1981; Wells 1986, 1991; Scott *et al.* 1990; Wells *et al.* 1987), Lemon Bay (Wells *et al.* 1996b), and Charlotte Harbor/Pine Island Sound (Shane 1990; Wells *et al.* 1996b, 1997). In many cases, residents emphasize use of the bay, sound, or estuary waters, with limited movements through passes to the Gulf of Mexico (Shane 1977, 1990; Gruber 1981; Irvine *et al.* 1981; Lynn 1995, Maze 1997). These habitat use patterns are reflected in the ecology of the dolphins in some areas; for example, residents of Sarasota Bay, Florida lacked squid in their diet, unlike non-resident dolphins stranded on nearby Gulf beaches (Barros and Wells 1998).

Genetic data also support the concept of relatively discrete bay, sound, and estuary stocks. Analyses of mitochondrial DNA haplotype distributions indicate the existence of clinal variations along the Gulf of Mexico coastline (Duffield and Wells, in press). Differences in reproductive seasonality from site to site also suggest genetic-based distinctions between communities (Urian *et al.* 1996). Mitochondrial DNA analyses suggest finer-scale structural levels as well. For example, Matagorda Bay, Texas dolphins appear to be a localized population (NMFS unpublished data), and differences in haplotype frequencies distinguish between adjacent communities in Tampa Bay, Sarasota Bay, and Charlotte Harbor/Pine Island Sound, along the central west coast of Florida (Duffield and Wells 1991, in press). Examination of protein electrophoretic data resulted in similar conclusions for the Florida dolphins (Duffield and Wells 1986).

The long-term structure and stability of at least some of these communities is exemplified by the residents of Sarasota Bay, Florida. This community has been observed since 1970 (Irvine and Wells 1972; Scott *et al.* 1990; Wells 1991). The number of dolphins regularly occupying the Sarasota Bay area has remained consistently at about 100. At least four generations of identifiable residents currently inhabit the region, including half of those first identified in 1970. Maximum immigration and emigration rates of about 2-3% have been estimated (Wells and Scott 1990).

Genetic exchange occurs between resident communities; hence the application of the demographically and behaviorally-based term "community" rather than "population" (Wells 1986). Up to about 30% of calves in Sarasota Bay apparently have been sired by non-residents (Duffield and Wells in press). A variety of potential exchange mechanisms occur in the Gulf. Small numbers of inshore dolphins traveling between regions have been reported, with patterns ranging from traveling through adjacent communities (Wells

1986; Wells *et al*. 1996a,b) to movements over distances of several hundred km in Texas waters (Gruber 1981; Würsig and Lynn 1996; Würsig unpublished data). In many areas year-round residents co-occur with non-resident dolphins, providing potential opportunities for genetic exchange. About 17% of group sightings involving resident Sarasota Bay dolphins include at least one non-resident as well (Wells *et al*. 1987). Similar mixing of inshore residents and non-residents is seen off San Luis Pass, Texas (Maze 1997). Non-residents exhibit a variety of patterns, ranging from apparent nomadism recorded as transience in a given area, to apparent seasonal or non-seasonal migrations. Passes, especially the mouths of the larger estuaries, serve as mixing areas. For example, several communities mix at the mouth of Tampa Bay, Florida (Wells 1986), and most of the dolphins identified in the mouths of Galveston Bay and Aransas Pass, Texas were considered transients (Henningsen 1991; Bräger 1993; Weller 1998).

Seasonal movements of dolphins into and out of some of the bays, sounds, and estuaries provide additional opportunities for genetic exchange with residents, and complicate the identification of stocks in coastal and inshore waters. In small bay systems such as Sarasota Bay, Florida and San Luis Pass, Texas residents move into Gulf coastal waters in fall/winter, and return inshore in spring/summer (Irvine *et al*. 1981; Maze 1997). In larger bay systems, seasonal changes in abundance suggest possible migrations, with increases in more northerly bay systems in summer, and in more southerly systems in winter. Fall/winter increases in abundance have been noted for Matagorda Bay (Gruber 1981; Lynn 1995; Würsig and Lynn 1996), Aransas Pass (Shane 1977; Weller 1998), Tampa Bay (Scott *et al*. 1989), and Charlotte Harbor/Pine Island Sound (Thompson 1981; Scott *et al*. 1989). Spring/summer increases in abundance have been reported for Galveston Bay (Henningsen 1991; Bräger 1993; Fertl 1994) and Mississippi Sound (Hubard 1998).

Much uncertainty remains regarding the structure of bottlenose dolphin stocks in many of the Gulf of Mexico bays, sounds, and estuaries. Given the apparent co-occurrence of resident and non-resident dolphins in these areas, and the demonstrated variations in abundance, it appears that consideration should be given to the existence of a complex of stocks, and to the roles of bays, sounds, and estuaries for stocks emphasizing Gulf of Mexico coastal waters. A starting point for management strategy should be the protection of the long-term resident communities, with their multi-generational geographic, genetic, demographic, and social stability. These localized units would be at greatest risk from geographically-localized impacts. Complete characterization of many of these basic units would benefit from additional photo-identification, telemetry, and genetic research (Wells 1994).

The current provisional stocks follow the designations in Table 1, with a few revisions. Available information suggests that Block B35, Little Sarasota Bay, can be subsumed under Sarasota Bay, and B36, Caloosahatchee River, can be considered a part of Pine Island Sound. As more information becomes available, additional combination or division may be warranted. For example, a number of geographically and socially distinct subgroupings of dolphins in regions such as Tampa Bay, Charlotte Harbor, Pine Island Sound, Aransas Pass, and Matagorda Bay have been identified, but the importance of these distinctions to stock designations remain undetermined (Shane 1977; Gruber 1981; Wells *et al*. 1996a,b, 1997; Würsig and Lynn 1996).

Understanding the full complement of the stock complex using the bay, sound, and estuarine waters of the Gulf of Mexico will require much additional information. The development of biologically-based criteria to better define and manage stocks in this region should integrate multiple approaches, including studies of ranging patterns, genetics, morphology, social patterns, distribution, life history, stomach contents, isozyme analyses, and contaminant concentrations. Spatially-explicit population modeling could aid in evaluating the implications of community-based stock definition. As these studies provide new information on what constitutes a bottlenose dolphin "biological stock,"
current provisional definitions will likely need to be revised. As stocks are more clearly identified, it will be possible to conduct abundance estimates using standardized methodology across sites (thereby avoiding some of the previous problems of mixing results of aerial and boat-based surveys), identify fisheries and other human impacts relative to specific stocks, and perform individual stock assessments. As recommended by the Atlantic Scientific Review Group (November 1998, Portland, Maine), a workshop will be held during 1999 to review current information pertaining to bottlenose dolphin stock structure in Gulf of Mexico bays, sounds, and estuaries, conduct simulations of alternative stock structure and, if warranted, propose a new stock structure.

Table 1. 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. Blocks with an abundance of zero were surveyed but not considered stocks at this time (but see Note 1 below).

Blocks	Gulf of Mexico Estuary	N_{BEST}	CV	N_{MIN}	PBR	Year	Reference
B51	Laguna Madre	80	1.57	31	0.3	1992	A
B52	Nueces Bay, Corpus Christi Bay	58	0.61	36	0.4	1992	A
B50	Compano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay	55	0.82	30	0.3	1992	A
B54	Matagorda Bay, Tres Palacios Bay, Lavaca Bay	61	0.45	42	0.4	1992	A
B55	West Bay	29	1.10	14	0.1	1992	A
B56	Galveston Bay, East Bay, Trinity Bay	152	0.43	107	1.1	1992	A
B57	Sabine Lake	0[1]	-			1992	A
B58	Calcasieu Lake	0[1]	-			1992	A
B59	Vermillion Bay, West Cote Blanche Bay, Atchafalaya Bay	0[1]	-			1992	A
B60	TerreBonne Bay, Timbalier Bay	100	0.53	66	0.7	1993	A
B61	Barataria Bay	219	0.55	142	1.4	1993	A
B30	Mississippi River Delta	0[1]	-			1993	A
B02-05, 29,31	Bay Boudreau, Mississippi Sound	1,401	0.13	1,256	13	1993	A
B06	Mobile Bay, Bonsecour Bay	122	0.34	92	0.9	1993	A
B07	Perdido Bay	0[1]	-			1993	A
B08	Pensacola Bay, East Bay	33	0.80	18	0.2	1993	A
B09	Choctawhatchee Bay	242	0.31	188	1.9	1993	A
B10	St. Andrew Bay	124	0.57	79	0.8	1993	A
B11	St. Joseph Bay	0[1]	-			1993	A
B12-13	St. Vincent Sound, Apalachicola Bay, St. Georges Sound	387	0.34	293	2.9	1993	A
B14-15	Apalachee Bay	491	0.39	358	3.6	1993	A
B16	Waccasassa Bay, Withlacoochee Bay, Crystal Bay	100	0.85	54	0.5	1994	A
B17	St. John's Sound, Clearwater Harbor	37	1.06	18	0.2	1994	A
B32-34	Tampa Bay	559	0.24	458	4.6	1994	A
B20	Sarasota Bay	97	na[3]	97	1.0	1992	B
B35	Little Sarasota Bay	2[2]	0.24	2	0.0	1985	C
B21	Lemon Bay	0[1]	-			1994	A
B22-23	Pine Sound, Charlotte Harbor, Gasparilla Sound	209	0.38	153	1.5	1994	A
B36	Caloosahatchee River	0[1,2]	-			1985	C
B24	Estero Bay	104	0.67	62	0.6	1994	A
B25	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	208	0.46	144	1.4	1994	A
B27	Whitewater Bay	242	0.37	179	1.8	1994	A
B28	Florida Keys (Bahia Honda to Key West)	29	1.00	14	0.1	1994	A

References: A- Blaylock and Hoggard 1994; B- Wells 1992; C- Scott et al. 1989

Notes:

[1] During earlier surveys (Scott *et al.* 1989), the range of seasonal abundances was as follows: B57, 0-2 (CV= 0.38); B58, 0-6 (0.34); B59, 0-0; B30, 0-182(0.14); B07, 0-0; B21, 0-15(0.43); and B36, 0-0.

[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.

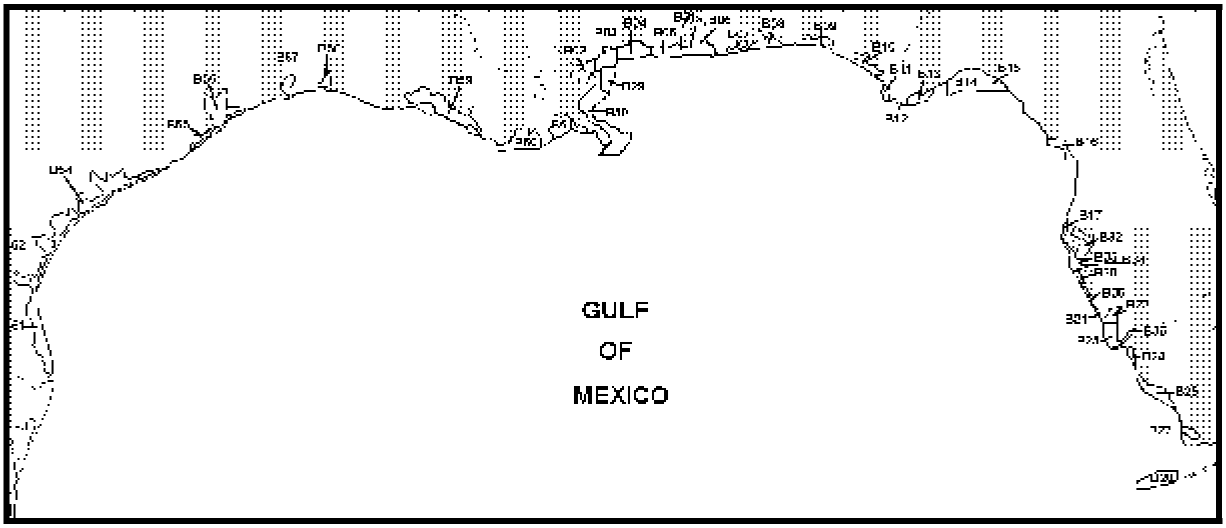

Figure 1. *U.S. Gulf of Mexico bays and sounds. Each of the alpha-numerically designated blocks corresponds to one of the NMFS Southeast Fisheries Science Center logistical aerial survey areas listed in Table 1. The bottlenose dolphins inhabiting each bay and sound are considered to comprise a unique stock for purposes of this assessment.*

POPULATION SIZE

Population size (Table 1) 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 in September-November 1994 along the west coast of Florida (NMFS unpublished data). Standard line-transect perpendicular sighting distance analytical methods (Buckland *et al.* 1993) and the computer program DISTANCE (Laake *et al.* 1993) were used. Stock size in Sarasota Bay, Florida, was obtained through direct count of known individuals (Wells 1992).

Minimum Population Estimate

The minimum population estimate (Table 1) is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). 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.

Current Population Trend

The data are insufficient to determine population trends for all of the Gulf of Mexico bay, sound, and estuary bottlenose dolphin communities. The Sarasota Bay community, however, has been monitored since 1970 and has remained relatively constant over the last 20+ years at approximately 105 animals (Wells 1998). Three anomalous mortality events have occurred among portions of these dolphin communities between 1990 and 1994; however, it is not possible to accurately partition the mortalities between bay and coastal stocks, thus the impact of these mortality events on communities is not known.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the dolphin communities that comprise these stocks. While productivity rates may be estimated for individual females within communities, such estimates are confounded at the stock level due to the influx of dolphins from adjacent areas which balance losses, and the unexplained loss of some individuals which offset births and recruitment (Wells 1998). Continued monitoring and expanded survey coverage will be required to address and develop estimates of productivity for these dolphin communities. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (Wade and Angliss 1997). The "recovery" factor, which accounts for endangered, depleted, and threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because these stocks are of unknown status. PBR for each stock is given in Table 1.

ANNUAL HUMAN-CAUSED MORTALITY AND 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 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, and the condition of the carcass if badly decomposed can inhibit the interpretation of cause of death.

A total of 1,881 bottlenose dolphins were found stranded in the USA Southeast Gulf of Mexico from 1993 to 1997 (Table 2) (NMFS unpublished data). Of these, 57 or 3% showed evidence of human interactions as the cause of death (*e.g*., gear entanglement, mutilation, gunshot wounds). Bottlenose dolphin are known to become entangled in recreational and commercial fishing gear (Wells *et al*. 1998; Gorzelany 1998; Wells and Scott 1994) and some are struck by recreational and commercial vessels (Wells and Scott 1997). In 1998 alone, two resident bottlenose dolphins and an associated calf were killed by vessel strikes and a resident young-of-the-year died from entanglement in a crab-pot float line (R.S. Wells personal communication).

The Gulf of Mexico menhaden fishery was observed to take 9 bottlenose dolphins (three fatally) between 1992 and 1995 (NMFS unpublished data). There were 1,366 sets observed out of 26,097 total sets, which if extrapolated for all years suggests that as many as 172 bottlenose dolphins could have been taken in this fishery with up to 57 animals killed. An observer program is urgently needed to obtain statistically reliable information for this fishery on the number of sets annually, the incidental take and mortality rates, and the communities from which bottlenose dolphins are being taken.

Some of the bay, sound and estuarine communities 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 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 with 202 dolphins taken 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 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 Information

Annual fishing effort for the shrimp trawl fishery in the USA 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; McFee and Brooks, Jr. 1998; NMFS unpublished data), indicating the possibility of entanglement with crab pot lines. 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 were not 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.

Table 2. Bottlenose dolphin strandings in the USA Gulf of Mexico (West Florida to Texas) from 1993 to 1997. Data are from the Southeast Marine Mammal Stranding Database (SESUS).

State		1993	1994	1995	1996	1997	Total
Florida							
	No. Stranded	134	51	101	133	63	482
	No. Human Interactions	4	2	3	2	0	11
	% With Human Interactions	3%	4%	3%	2%	0%	2%
Alabama							
	No. Stranded	48	16	15	17	14	110
	No. Human Interactions	1	0	1	0	1	3
	% With Human Interactions	2%	0%	7%	0%	7%	3%
Mississippi							
	No. Stranded	64	25	32	59	42	222
	No. Human Interactions	4	0	4	2	2	12
	% With Human Interactions	6%	0%	12%	3%	5%	5%
Louisiana							
	No. Stranded	14	74	31	92	42	253
	No. Human Interactions	0	0	1	3	1	5
	% With Human Interactions	0%	0%	3%	3%	2%	2%
Texas							
	No. Stranded	133	227	110	208	136	814
	No. Human Interactions	4	6	7	7	2	26
	% With Human Interactions	0%	3%	6%	3%	0%	3%
Totals							
	No. Stranded	393	393	289	509	297	1881
	No. Human Interactions	13	8	16	14	6	57
	% With Human Interactions	3%	2%	6%	3%	2%	3%

Other Mortality

The near shore 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 USA 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 found to be 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. However, a recent health assessment of 35 bottlenose dolphins from Matagorda Bay, Texas associated high levels of chlorinated hydrocarbons with low health assessment scores (Reif *et al*., in review). Morbillivirus has also been implicated in the deaths of bottlenose dolphins in some of these communities (Duignan *et al*. 1996).

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 USA 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 USA Gulf of Mexico may have experienced a 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 review), and it is possible that other estuarine resident stocks have been exposed to the morbillivirus (Duignan *et al*. 1996).

The relatively high number of bottlenose dolphin deaths which occurred during the mortality events in the last decade suggests that some of these stocks may be stressed. 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, it is not insignificant and approaching the zero mortality and serious injury rate. 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.

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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 1989). 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* sp. Sightings of this category were documented in all seasons during seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). The few reliable sightings of dwarf sperm whales during those surveys were more numerous in spring, probably a result of greater survey efforts in that season (Jefferson and Shapiro 1997). Pygmy and dwarf sperm whales have been sighted in the northwestern Gulf of Mexico in waters 1000 m deep, on average (Davis *et al*. 1998). However, these authors cautioned that inferences on preferred bottom depths should await surveys for the entire Gulf of Mexico. The difficulty in sighting pygmy and dwarf sperm whales may be exacerbated by their avoidance reaction towards ships, and change in behavior towards approaching survey aircraft (Würsig *et al*. 1998). In a recent study using hematological and stable-isotope data, Barros *et al*. (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales, and/or dive deeper during feeding bouts. There is no information on stock differentiation.

POPULATION SIZE

Estimates of abundance of *Kogia* sp. 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 (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the USA coast to the seaward extent of the USA Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the species' range and therefore, these data were not used to estimate population size. Estimated abundance of *Kogia* sp. 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* sp. 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.

Minimum Population Estimate

A minimum population estimate was not calculated because of uncertainty of species identification at sea.

Current Population Trend

There is insufficient information to describe any population trend of this species in the Gulf of Mexico.

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. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one half the maximum net productivity rate, and a "recovery" factor (Wade and Angliss 1997). The "recovery " factor, which accounts for endangered, depleted, and threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the dwarf sperm whale is unknown because the minimum population estimate 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 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-October 1998 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.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the USA 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 16 dwarf sperm whale strandings were documented in the northern Gulf of Mexico from 1990 through October 1998.

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. 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. The total level of fishery-related mortality and serious injury is unknown, but it is believed to be insignificant.

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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 1989). 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* sp. Sightings of this category were documented in all seasons during seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al.* 1996). The difficulty in sighting pygmy and dwarf sperm whales may be exacerbated by their avoidance reaction towards ships, and change in behavior towards approaching survey aircraft (Würsig *et al.* 1998) In a recent study using hematological and stable-isotope data, Barros *et al.* (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales, and/or dive deeper during feeding bouts. There is no information on stock differentiation.

POPULATION SIZE

Estimates of abundance of *Kogia* sp. 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 (Hansen *et al.* 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the USA coast to the seaward extent of the USA Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the species' range and therefore, these data were not used to estimate population size. Estimated abundance of *Kogia* sp. 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* sp. 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.

Minimum Population Estimate

A minimum population estimate could not be calculated because of uncertainty of species identification at sea.

Current Population Trend

There is insufficient information to describe any population trend for this species in the Gulf of Mexico.

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. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one half the maximum net productivity rate, and a "recovery" factor (Wade and Angliss 1997). The "recovery " factor, which accounts for endangered, depleted, and threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the pygmy sperm whale is unknown because the minimum population estimate cannot be estimated.

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-October 1998 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.

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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 20 pygmy sperm whale strandings were documented in the northern Gulf of Mexico from 1990 through October 1998. Two of these animals had a plastic bag or pieces thereof in their ~~its~~ stomachs (Tarpley and Marwitz 1993, Barros, unpublished data). Another animal 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. 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. The total level of fishery-related mortality and serious injury is unknown, but it is believed to be insignificant.

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Appendix I[1]. Observer comments relating to condition of marine mammals observed caught in 1994-1997 by US pelagic longline vessels operating in the Atlantic. Listing includes unique trip identifier (TRIP #), date of capture, species taken, latitude (Lat), longitude (Lon), and comments. Information provided by M. Tork (NEFSC) and D. Lee (SEFSC).

Trip #	Date	Species	Lat	Lon	Comments
A02	1/8/94	Pilot whale	37 15	74 20	alive; cut from gear; condition unknown
A28030	8/9/94	Pilot whale	39 01	72 41	alive; mainline wrapped around fluke; one end of linecut and the other pulled to free animal; animal swam away
	8/16/94	Pilot whale	38 55	72 51	hooked in pectoral fin; gangion cut and animal swam away
A32006	8/11/94	Pilot whale	37 15	74 29	alive; gangion cut; animal swam away
	8/11/94	Pilot whale	37 15	74 29	same as previous entry
	8/11/94	Pilot whale	37 15	74 29	same as previous entry
	8/11/94	Pilot whale	37 15	74 29	same as previous entry
	8/11/94	Pilot whale	37 15	74 29	same as previous entry
	8/12/94	Pilot whale	37 20	74 20	tangled in mainline; cut free; swam away
A32008	8/26/94	Risso's dolphin	38 45	72 54	dead; animal wrapped in gear; mainline wrapped around body immediately adjacent to flukes
A44004	9/16/94	Pilot whale	38 24	73 24	alive; hooked in dorsal fin; mainline cut to release animal with gangion still attached
	9/17/94	Pilot whale	38 16	73 30	animal cut from mainline several wraps of mainline and part of gangion around base of flukes/tail; animal swam off slowly
	9/18/94	Risso's dolphin	38 02	73 17	hooked in mouth; broke gangion from mainline; released alive
	9/19/94	Pilot whale	37 50	73 19	hooked in mouth; broke gangion from mainline; swam away strongly trailing 50 fathoms of mainline from its mouth
	9/21/94	Risso's dolphin	39 52	70 02	hooked in tail fluke and mainline; gear cut to release animal; swam away with mainline and leader around tail
A53037	9/21/94	Risso's dolphin	39 55	69 20	alive; gear wrapped around animal; cut loose by crew; swam away quickly
A54003	9/21/94	Killer whale	47 24	40 48	alive
A62002	10/21/94	Risso's dolphin	39 48	69 59	a good amount of mainline was tangled around animal; released with a fair amount of mainline around fluke; some blood noticed around caudal peduncle
	10/25/94	Risso's dolphin	39 44	70 54	hooked in mouth; animal released with hook in mouth and approximately 7 fathoms of 4001 b test line trailing from mouth
	10/27/94	Risso's dolphin	39 46	70 56	apparently hooked in mouth; appeared to be wound up the midsection of the body with line; animal swam off quite sluggishly

Appendix I (continued).

Trip #	Date	Species	Lat	Lon	Comments
A54005	12/9/94	Pilot whale	35 42	74 42	alive; gear around flipper
	12/9/94	Pilot whale	35 42	74 42	alive; gear around body
F15	6/18/94	Pantropical Spotted dolphin		27 37	88 25 alive; tail wrapped in dropline; all line removed
F16	7/14/94	Atlantic spotted dolphin	29 07	87 20	alive; hook in corner of mouth, gangion line wrapped around mouth; line was removed but hook remained
A53034	8/30/95	Pilot whale	46 13	40 07	animal cut free; swam away quickly
A41031	8/9/95	Pilot whale	40 20	67 55	cut loose with leader still attached- line parted as it neared the vessel; "mouth hooked"
	8/12/95	Risso's dolphin	40 25	67 30	hooked in mouth; gangion cut to free animal; alive
A25041	8/10/95	Pilot whale	40 15	67 53	alive; animal hooked or maybe wrapped in mono; condition unknown
A44040	8/4/95	Pilot whale	37 33	74 10	hooked in flipper; cut from gangion; alive
	8/13/95	Risso's dolphin	39 25	72 02	alive; mainline and gangion wrapped around tail; all gear cut before animal released
A62058	8/11/95	Pilot whale	37 01	74 31	animal extensively wrapped in mainline around caudal peduncle; most of the line cut away; animal released with the remaining line trailing
A62058	8/14/95	Pilot whale	37 09	74 24	gear cut from animal; alive
A41032	8/30/95	Pilot whale	38 04	73 46	mouth hooked; line snapped and animal swam off
A44043	8/31/95	Risso's dolphin	39 43	71 49	mainline cut from around tail flukes and pulled from mouth; animal swam away quickly
	9/3/95	Pilot whale	39 05	72 30	hooked in flipper; gangion broke off as it was hauled
	9/7/95	Risso's dolphin	39 05	72 32	mainline cut from around tail flukes; animal swam off slowly after blowing
	9/28/95	Shortfin Pilot whale	38 21	73 31	hooked in mouth; gangion clipped as close to the mouth as possible; released with hook in mouth

Appendix I (continued).

Trip #	Date	Species	Lat	Lon	Comments
A41034	10/4/95	Pilot whale	37 00	74 36	animal swam away after breaking line; condition unknown
	10/10/95	Pilot whale	35 43	74 37	hooked in mouth; leader cut to free animal; condition unknown
	10/11/95	Pilot whale	35 46	74 42	Leader cut to free animal; condition unknown
	10/11/95	Pilot whale	35 46	74 42	same as previous entry except animal swam towards 3 other "waiting" whales and swam away with them
A44048	10/16/95	Pilot whale	37 45	73 25	hooked in mouth; cut from mainline; swam away trailing gangion and 100 feet of mainline
T12	10/23/95	Pilot whale	26 42	79 40	alive; entangled in mainline, mono cut away
F29	8/4/95	Unid MM	39 24	72 17	animal not seen by observer; crew was pulling in gangion when they noticed it was a mm; line broke and animal swan away; crew called out whale; other large dolphin (unknown) in area.F38
F38	7/28/96	Rissos's dolphin	29 01	87 47	Muscle tissue sample taken from the head, and the lower jaw was also saved. The animal was entangled in the main line and brought aboard dead
F39	8/30/96	Risso's dolphin	39 24	72 17	Mainline wrapped around flukes, unwrapped flukes, swam away
		Risso's dolphin	39 24	72 17	Mainline wrapped around flukes, unwrapped flukes, swam away
		Risso's dolphin	38 15	73 18	Hooked in mouth, line cut, 914 cm of line left attached (animal pulling very lively) swam away uninjured
K17	12/14/96	Unidentified mammal	30 26	76 55	Was tangled in line, black tail section seen just before dive, animal was free with no line attached
F45	2/25/97	Clymene dolphin			Tail wrapped in mainline; mainline cut free. Animal swam away healthy
F38	7/28/96	Risso's dolphin	27 40	87 31	Samples (mandible, skin, blubber, and muscle) taken.
0045	8/3/97	Pilot whale			Pilot whale brought up; animal sluggish but swimming at side of vessel. Gear was tangled and wrapped around flukes only. Main line and gangions were cut and all gear removed. Animal then swam slowly away. Only injury suffered were lacerations around flukes from gear, no knives used to free animal.

[1] This is Table 17 taken from: Johnson, D.R., C.A. Brown, and C. Yeung. 1999. Estimates of marine mammal and marine turtle catch by the US Atlantic pelagic longline fleet in 1992-1997. NOAA Tech. Mem. NOAA-SEFSC-418, 70p.

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