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This series represents a secondary level of scientific publishing. It consistently employs internal scientific review, and occasionally external scientific review. Unless otherwise noted, it also employs technical and copy editing.

U.S. Atlantic and Gulf of Mexico

Marine Mammal Stock Assessments -- 1996

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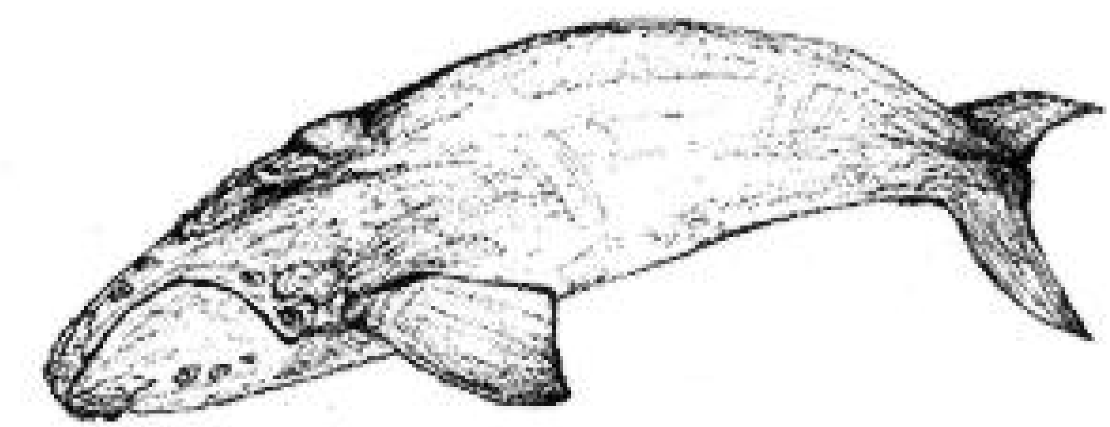
Editorial Note on This Issue

This document is the second edition of "U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments." The first edition, published in 1995, was issued in the NMFS Southeast Fisheries Science Center's subseries of the *NOAA Technical Memorandum* series (*i.e.*, *NOAA Tech. Memo. NMFS-SEFSC*). It is intended that issuance of future editions will continue to alternate between that subseries and this subseries (*i.e.*, *NOAA Tech. Memo. NMFS-NE*).

Both editions have adopted a common format and style to assist those who will be regularly referencing these documents. Accordingly, this issue of the *NOAA Tech. Memo. NMFS-NE* has not undergone the normal technical and copy editing by this subseries' technical editor. 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 vii).



IN MEMORIAM

Robert A. Blaylock III
9/15/47 - 12/31/96

“Ben” Blaylock, lead editor of the 1995 U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments, and a research biologist in the marine mammal program at the National Marine Fisheries Service (NMFS) Miami Laboratory died on December 31, 1996, after being diagnosed with esophageal cancer a year prior.

Ben was born in Waco, Texas. He was enlisted in the U.S. Navy, serving four years and rose to the rank of Ensign. He received his discharge in Norfolk, Virginia, and spent most of his adult life in that area. He attended and graduated from Christopher Newport College at Newport News, Virginia, received his masters degree from William and Mary College in Williamsburg and was accepted into the graduate program at the Virginia Institute of Marine Science (VIMS). Ben spent several years at VIMS working on his Ph.D.

After receiving his Ph.D. from VIMS in 1989, he went to work for the NMFS in Miami, Florida. He participated in marine mammal census operations, the stranding network, served as NMFS regional coordinator for the Atlantic and Gulf of Mexico Scientific Review Group, wrote several technical manuals, and was editor of the newsletter *Strandings*. Ben had a strong interest in both writing and marine mammals, as evidenced in the several documents and publications he authored and co-authored.

Ben was blessed with many good friends in the scientific community. During his stay in the hospital in the last few weeks of his life, he received hundreds of E-mail messages which his mother would read to him. These messages bolstered his spirit as they mostly contained stories of how Ben had someway helped them. We are proud of his courage to try to overcome his illness despite overpowering odds against his survival. The marine mammal community has lost a valued colleague and friend.

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ACKNOWLEDGMENTS

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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 SARs.

In this document, major revisions and updating of the SARs were only completed for strategic stocks. These are identified by the 1997 date-stamp at the top right corner at the beginning of each report. Except for some minor editorial changes, stocks designated by the 1995 date-stamp are unchanged from the 1995 document (Blaylock *et al.* 1995).

REFERENCES

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

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

New England waters are a primary feeding habitat for the right whale, which appears to feed primarily on calanoid copepods in this area. Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently. These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitat (Kenney *et al*. 1986). The acceptable surface copepod resource is limited to perhaps 3% of the region during the peak feeding season in Cape Cod and Massachusetts Bays (Mayo and Goldman, 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 is providing insights to stock definition. Schaeff *et al*. (1993) suggested that western North Atlantic right whales probably represent a single breeding population that may be based on three matrilines. To date, skin biopsy sampling has resulted in the compilation of a DNA library of 205 North Atlantic right whales. When work is completed (December 1998) 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 unity ($P<0.001$) (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 major wintering and summering grounds have yet to be described.

POPULATION SIZE

Based on a census of individual whales identified using photo-identification techniques, the western North Atlantic population size was estimated to be 295 individuals in 1992 (Knowlton *et al*. 1994). Because this was a nearly complete census, it is assumed that this represents a minimum population size estimate.

Historical Population Estimate

An estimate of pre-exploitation population size is not available. Basque whalers may have taken as many as 200 right whales a year at times during the 1500s in the Strait of Belle Isle region, and the stock of right whales may have already been substantially reduced by the time whaling was begun by colonists in the Plymouth area in the 1600s (Reeves and Mitchell 1987). A modest but persistent whaling effort along the eastern U.S. lasted three centuries, and the records include one report of 29 whales killed in Cape Cod Bay in a single day during January 1700. Based on incomplete historical whaling data, these authors could only conclude that there were at least some hundreds of right whales present in the western North Atlantic during the late 1600s. In a later study (Reeves *et al*. 1992), a series of population trajectories using historical data and an estimated present population size of 350 were plotted. The results suggest that there may have been at least 1,000 right whales in this population during the early to mid-1600s, with the greatest population decline occurring in the early 1700s. The authors cautioned, however, that the record of removals is incomplete, the results are preliminary, and refinements are required. 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 current population growth rate reported by Knowlton *et al*. (1994) of 2.5% (CV = 0.12) suggests that the stock is showing signs of slow recovery.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

During 1980-1992, 145 calves were born to 65 identified cows. The number of calves born annually ranged from five 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, 8; 94/95, 7; and 95/96, 22. (The total calf production was reduced by reported calf mortalities: 2 in 1993, and 3 in 1996. Of the three calf mortalities in 1996, available data suggested one was not included in the reported 21 mother/calf pairs, resulting in a total of 22 calves born.) Of the 46 adult females considered to be available for calving in the 95/96 season, only 10 were documented to calve. The remaining 11 mothers were first observed with calves this 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, suggesting that the calving interval was increasing (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 current annual population growth rate during 1986-1992 was estimated to be 2.5% (CV = 0.12) using photo-identification techniques (Knowlton *et al*. 1994). A population increase rate of 3.8% was estimated from the annual increase in aerial sighting rates in the Great South Channel, 1979-1989 (Kenney *et al*. 1995). The current estimated population growth rate of the western North Atlantic stock is lower than that of the four stocks of southern-hemisphere right whales for which data are available: western Australia, 12.7%; Argentina, 7.3%; east and west Africa, 6.8% (Best 1993). 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).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) was specified as the product of minimum population size, one-half the maximum net productivity rate (1/2 of 2.5%), and a "recovery" factor for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP (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.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 1991 through September 1996, the total estimated human-caused mortality and serious injury to right whales is estimated as 2.5 per year. This is derived from three components: 1) the observed fishery, 0.4; 2) additional fishery impact records, 0.7; and 3) ship strike records, 1.4.

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 one area of concern, the coastal waters of the southeastern U.S., an awareness and mitigation program, involving ten agencies and organizations, began in 1992, and has been upgraded and expanded annually. Other areas may be included in the future. For waters of the northeastern U.S., a present concern, not yet completely defined, is the possibility of habitat degradation in Massachusetts and Cape Cod bays due to a Boston sewage outfall now under construction. Timetables for levels of treatment are under discussion.

Fishery-Related Serious Injury and Mortality

Total estimated average annual fishery-related mortality and serious injury in fisheries monitored by NMFS during 1991-1995 was 0.4 right whales annually (CV=0.33) (Table 1). This estimate is based on the entanglement and serious injury of a 1½ year-old female in a pelagic drift gillnet on southern Georges Bank in July 1993.

Additional 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 2). The examination of the large whale entanglement records from sources other than the observer program show that during 1991-96 (1996 incomplete), 6 of 13 records of mortality or serious injury likely to result in mortality included entanglement or fishery interaction effects. The reports often do not contain the detail necessary to assign the entanglements to a particular fishery or location. On the other hand, 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 perhaps directly or indirectly, the cause of the mortality. Lobster gear was also reported to be present in the July 1993 pelagic drift gillnet entanglement described above. While entanglement may be a contributing rather than a principal impact in some cases, these events (records from other than the observed fishery) increase the number of right whales per year with a serious fishery interaction, and result in a larger number than the 0.4 estimated mortality or serious injury take from the observed fishery. From Table 2, the 4 records where entanglement or fishery interaction was a primary cause result in an estimate of an additional 0.7 mortalities or serious injuries to right whales per year (based on 4 records in 5.8 years).

In January 1997 (62 FR 33, Jan. 2, 1997), NMFS changed the classification of the Gulf of Maine and U.S. 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 two right whale records: the 9 July 1993 record shown in Table 1, and the 17 July 1995 record shown in Table 2).

Table 1. Summary of the incidental mortality of North Atlantic right whales (*Eubalaena glacialis*) 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	91-95	1994=12 1995=11	Obs. Data Logbook	.20, .40, .42, .87, .99	0, 0, 1[5], 0, 0	0.5, 0.4, 1.3, 0, 0	1.00, 1.00, .25, 0, 0	0.4 (.33)
TOTAL								0.4 (.33)

[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] 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 (Bisack, in prep.).

[5] Animal was released alive and injured. A mortality estimate was made given the poor condition of the animal during two re-sightings in 1993, and the absence of sightings since. Note that other line, identified as lobster gear, was present prior to the pelagic drift gillnet entanglement.

Fishery Information

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 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 either the pelagic longline, pelagic pair trawl, or other fisheries monitored by NMFS.

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, and 1995 was 233, 243, and 232, 197, and 164 respectively. Fifty-nine vessels participated in this fishery between 1989 and 1993. In 1994 and 1995 there were 12 and 11 vessels, respectively, in the fishery. 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 (Table 1). 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). In July of 1993, a 1½ year-old female was released from a pelagic drift gillnet along the southern edge of Georges Bank. The wounding to the animal, including the tail region, suggested a high likelihood of reduced viability. Under the assumption that this animal eventually died, the total estimated annual fishery-related mortalities (CV in parentheses) were 2.2 in 1989 (1.00), 3.4 in 1990 (1.00), 0.5 (1.00) in 1991, 0.4 in 1992 (1.00), 1.3 in 1993 (0.25), 0 in 1994 (0), and 0 in 1995 (0). Total estimated average annual fishery-related mortality and serious injury in fisheries monitored by NMFS during 1991-1995 was 0.4 right whales annually (CV=0.33) (Table 1).

As described, in this stock, 57% of living right whales bore evidence of entanglements with fishing gear (Kraus 1990). 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 U.S. 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 1991 through 1996 have been summarized in Table 2, yielding a human-induced, non-fishery-related mortality rate of between 1 and 3 right whales a year.

In the period January to March 1996, an ‘unusual mortality event’ was declared for right whales in southeastern U.S. waters. Five mortalities were reported, however, in only one case was an anthropogenic factor ascribed as the proximate cause of the mortality (the 2/1/96 report in Table 2). In addition to the report included in Table 2, a calf beached on January 2, a floating 35 ft female carcass was reported on February 7 (no necropsy), a female calf on 19 February was recovered and necropsied, and a male calf was recovered from offshore Georgia on 22 February. In three of these mortality events, human impacts were not indicated, and/or the cause of death was reported as unknown. However, the lack of a recovered carcass and subsequent necropsy in the 2/7 event introduces uncertainty as to the cause of death. While the 1996 mortalities were the highest recorded to date, on the other hand, the increased 1996 mortality may have been, at least in part, an apparent increase, because: 1) 4 of the 5 were reported from areas offshore of those normally surveyed, and 2) a larger-than-usual number of right whales were documented in the southeastern U.S. habitat in the 95/96 season.

Table 2. Summarized records of mortality and serious injury likely to result in mortality, North Atlantic right whales, January 1991-September 1996. This listing includes only records related to U.S. commercial fisheries and/or U.S. waters. Cause of mortality or injury, assigned as primary or secondary, based on records maintained by NMFS/NER.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary			Notes
				Ship strike	Entang./ Fsh.inter	Unknown uncertain	
3/12/91	mortality, beached	2 y.o. female #1907	Amelia I. FL	P	S		fractured skull; net, line, buoys
7/6/91	mortality, offshore	calf	offshore NJ	P			documented vessel strike
1/5/93	mortality, offshore	calf	St. Augustine, FL	P			documented vessel strike
12/12/93	mortality, offshore	female	offshore VA	P		S	photos show gash
2/22/94	serious injury	calf #2404	offshore NE FL		P	S	scars, wounds, flukes limp
11/16/94	serious injury	3 y.o. juv., #2151	nr. Plum I., MA		P		entangled head, 3 tail wraps, unsuccessful disentanglement
7/17/95	mortality, beached	2 y.o. male #2366	Middletown, RI		P		line through mouth, embedded deeply right flipper
8/13/95	serious injury, offshore	adult female, #1045	S. Georges Bank	P		S	large head wound, bone exposed
10/20/95	mortality, beached	adult male, #2250	Long I., N.S.	P		S	wound in back, spine damaged, prob. ship strike
2/1/96	mortality, offshore	adult male, #1623	offshore GA	P		S	trauma event, skull shattered
3/10/96	mortality, beached	adult male #2220	Cape Cod MA	P	S		wounds, slice in back, lobster gear
8/5/96	serious injury	unknown	SE of Gloucester, MA		P		unknown type of gear entangled around head, judged to be a life threatening entanglement

Table notes

1) Assigned cause based on best judgement of available data. Additional information may result in revisions.
2) Entanglements of juvenile whales may become more serious as whale grows.
3) There is no overlap between tables 1 and 2 (the July 1993 record from the observed fishery is not included in Table 2).

Several additional factors are need to be considered when considering mortality and serious injury to right whales: 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) in entanglements, several types of gear may be involved, 4) possible human-impacts aside from ship strikes and entanglements have been reported, 5) 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, and, lastly, 6) the actual vessel or gear type/source is often uncertain.

With these caveats, the average reported mortality and serious injury to right whales due to ship strikes was 1.4 whales per year (8 ship strike events in 5.8 years) during 1991-96. The total estimated annual average human-induced mortality and serious injury (including fishery and non-fishery related causes) was 2.5 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 2.5 estimate must be regarded as a minimum estimate. Of the mortality and serious injury in U.S. waters, 56% was attributable to ship strikes, and 44% to entanglement/fishery interaction.

While this assessment relates to U.S. fisheries and U.S. waters, there are, additionally, a number of records from Canadian waters. Three records are noteworthy: 1) the mortality of whale #1223 on 5 September 1992 in the Bay of Fundy was attributed to a probable ship strike, 2) whale #1247 was sighted 21 September 1994 in the Bay of Fundy entangled with line of unknown gear type tightly wrapped and has not been sighted since. This is considered a serious injury (A.R. Knowlton, pers. comm.), and 3) whale #2220, which came ashore on Cape Cod on 10 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.

STATUS OF STOCK

The size of this stock is considered to be low relative to OSP in the U.S. 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 U.S., were designated by NMFS (59 FR 28793, June 3, 1994). The NMFS ESA 1996 Northern Right Whale Status Review, now in draft, 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 2.5 right whales per year since 1991. 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*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

Clapham *et al*. (1993) reported a high degree of individual site fidelity, both within and between years, from a long-term study of identified humpback whales in waters off Cape Cod. Some reproductive parameters which have been estimated for humpback whales from this area are discussed below.

An increased number of sightings of young humpback whales in the vicinity of the Chesapeake and Delaware bays occurred in 1992 (Swingle *et al*. 1993). Wiley *et al*. (1995) reported 38 humpback whale strandings which occurred during 1985-1992 in the U.S. mid-Atlantic and southeastern states. Humpback whale strandings increased, particularly along the Virginia and North Carolina coasts, and most stranded animals were sexually immature. They concluded that these areas are becoming an increasingly important habitat for juvenile humpback whales and that anthropogenic factors may negatively impact whales in this area. There have also been a number of wintertime humpback sightings in coastal waters of the southeastern U.S. (NMFS unpublished data; New England Aquarium unpublished data; Florida DEP, unpublished data). Whether the increased sightings represent a distributional change, or are simply due to an increase in sighting effort, is presently unknown.

Feeding is the principal activity of humpback whales in New England waters, and their distribution in New England waters has been largely correlated to prey species and abundance, although behavior and bottom topography are factors in foraging strategy (Payne *et al*. 1986, 1990). Humpback whales are believed to be largely piscivorus when in these waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes dubius*), and other small fishes. Commercial depletion of herring and mackerel led to an increase in sand lance in the southwestern Gulf of Maine in the mid 1970s with a concurrent decrease in humpback whale abundance in the northern Gulf of Maine. Humpback whales were densest over the sandy shoals in the southwestern Gulf of Maine favored by the sand lance during much of the late 1970s and early 1980s, and humpback distribution appeared to have shifted to this area (Payne *et al*. 1986). An apparent reversal began in the mid 1980s, and herring and mackerel increased as sand lance again decreased (Fogarty *et al*. 1991). Humpback whale abundance in the northern Gulf of Maine increased dramatically during 1992-93 , along with a major influx of herring (College of the Atlantic, pers. comm.). Humpback whales were few in nearshore Massachusetts waters in the 1992-93 summer seasons, and more abundant in the offshore waters of Cultivator Shoal and Northeast Peak on Georges Bank, and Jeffreys Ledge — more traditional areas of herring occurrence (Center for Coastal Studies, pers. comm.). In 1996, small sand lance returned to the Stellwagen Bank area, and humpback whales were once again relatively abundant. 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 (unpublished data, Center for Coastal Studies and College of the Atlantic). Humpback whales, their habitat, and their prey are also linked by a diverse repertoire of feeding behaviors (Hain *et al*. 1982; Hain *et al*. 1995).

A major research initiative was begun in early 1992 — the Years of the North Atlantic Humpback (YONAH) Project (Allen *et al*. 1993). This project is a large-scale, intensive, ocean-wide study of humpback whales throughout their entire

North Atlantic range conducted over three years. Photographs for individual identification and biopsy samples for genetic analyses were collected from both summer feeding areas in the northeast and breeding grounds in the West Indies. Data are now being analyzed to determine the current population status and genetic relationships of humpback whales throughout their range.

POPULATION SIZE

Two abundance estimates are available for humpback whales, one is of animals in the northeast U.S. Atlantic and the other of all humpbacks west of Iceland (Table 1).

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 were chosen because the greatest proportion of the population off the northeast U.S. 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 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.

Katona *et al*. (1994), using photo-identification techniques and Bailey's modification of the Chapman capture-recapture method, estimated that the total humpback whale population in the North Atlantic Ocean west of Iceland during the years 1979-1990 averaged 5,543 humpback whales (CV = 0.16; Table 1).

The best available current abundance estimate for the western North Atlantic humpback whale is 5,543 (CV=0.16) as estimated in Katona *et al*. (1994) because it is the most current and provided the most complete coverage of the known habitat.

Table 1. Summary of abundance estimates for Western North Atlantic humpback 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 and summer 1978-82	Cape Hatteras, NC to Nova Scotia	294	0.45
1979-90	N. Atlantic ocean west of Iceland	5,543	0.16

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for western North Atlantic humpback whales is 5,543 (CV=0.16). The minimum population estimate for this stock is 4,848 humpback whales (CV=0.16).

Current Population Trend

There are insufficient data with which to determine trends.

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. 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). A recent report where interbirth intervals were used estimated population growth rate at 6.5% (SE=0.012) (Barlow and Clapham 1997). These findings will be evaluated for use in future stock assessment reports.

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 4,848 (CV=0.16). 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 this stock is listed as an endangered species under the Endangered Species Act (ESA). PBR for the western North Atlantic humpback whale stock is 9.7 whales.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 1991 through 1995, the total estimated human-caused mortality and serious injury to humpback whales is estimated as 5.5 per year. This is derived from three components: 1) the observed fishery, 0.7; 2) additional fishery interaction records, 3.4; and 3) vessel collision records, 1.4. 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.

Background

As with right whales, human impacts (vessel collisions and entanglements) are factors slowing recovery of the 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

The total average annual estimated fishery-related mortality and serious injury in fisheries monitored by NMFS between 1991-1995 was 0.7 humpback whale (CV = 0.27) (Table 2). 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.

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 stranded or floating (dead, injured, and/or entangled) humpbacks for the period 1991 to 1995 were reviewed. In more than half the records, either advanced decomposition of beached animals, no evidence of human impacts, or reports of "animal freed itself" or "was disentangled" eliminated the records from further consideration. Of the remaining records, there were three mortalities were fishery interaction was possible or probable, and

14 records where serious injury attributable to fishery interaction was possible or probable—for a total of 17 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 do, however, suggest entanglements in addition to those reported by fishery observers.

If Canadian entanglements, the 17 records reported above, and the possible mid-Atlantic entanglement records reported above are considered, along with injuries that may lead to reduced viability and/or eventual mortality of formerly entangled whales, the total number of mortalities and serious injuries to humpback whales will be more than the 0.7 humpbacks per year estimated from observed fisheries alone.

Fishery Information

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 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 either the pelagic longline, pelagic pair trawl, or other fisheries monitored by NMFS.

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, and 1995 were 233, 243, and 232, 197, and 164 respectively. Fifty-nine vessels participated in this fishery between 1989 and 1993. In 1994 there were 12, and in 1995 there were 11 vessels in the fishery (Table 2). Observer coverage, percent of sets observed, was 20% in 1991, to 40% in 1992, 42% in 1993, 87% in 1994, and 99% in 1995. 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 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 logbooks. Variances were estimated using bootstrap re-sampling techniques (Bisack, in prep.). Estimated annual mortality (CV in parentheses), extrapolated from fishery observer data, was 0.7 (1.00) in 1991, 0.4 (1.00) in 1992, 1.5 in 1993 (0.34), 0 in 1994 (0), and 1.0 in 1995 (0). The total average annual estimated fishery-related mortality and serious injury in fisheries monitored by NMFS between 1991-1995 was 0.7 humpback whale (CV = 0.27) (Table 2).

In January 1997 (62 FR 33, Jan. 2, 1997), NMFS changed the classification of the Gulf of Maine and U.S. 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	91-95	1994=12 1995=11	Obs. Data Logbook	.20, .40, .42, .87, .99	0, 0, 1, 0, 1	0.7, 0.4, 1.5, 0, 1.0[5]	1.00, 1.00, 0.34, 0, 0	0.7 (.27)
TOTAL								0.7 (.27)

[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. 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). In 1994 and 1995, observer coverage increased substantially, and bycatch rates were not pooled for this period (Bisack, in prep).

[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 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

Table 3. Summarized records of mortality and serious injury likely to result in mortality, North Atlantic humpback whales, 1991-1995. This listing includes only records related to U.S. commercial fisheries and/or U.S. waters. Cause of mortality or injury assigned based on records maintained by NMFS/NER.

Date	Report type	Assigned cause	Photo ID, Sex/age	Location	Notes
5/31/91	mortality	fishery interaction	"Silver" adult female length = 13.9 m	40° 39' 73° 05'	line and/or cable from unknown gear; seen entangled several days before beaching, fresh scars, line through mouth, scars around pectorals, marks around mouth and jaw with exposed bone
8/1/91	serious injury	fishery interaction	"Stalactite" sex unknown length (est.) = 12 m	42° 51' 70° 45'	gillnet and assorted lobster, tuna gear and grappling hook; trailing 50' netting, net around mouth and tail; emaciated and tired; disentangled 8/11/91; in poor condition
8/28/91	serious injury	fishery interaction	"Manta" adult female born 1984	43° 15' 70° 03'	entangled around flukes with line, moving slowly, tired, gasping, hanging flesh between flukes, appears life threatening

Date	Report type	Assigned cause	Photo ID, Sex/age	Location	Notes
2/14/92	mortality	vessel collision	8.6 m female	Chesapeake Bay mouth	floater; propeller wounds, fractured mandible and eye socket,; injuries may not have been immediately fatal, some signs of healing present; animal very thin; boat collision
4/17/92	mortality	vessel collision	8.9 m female	National Seashore, Assateague, Maryland	possible boat strike, blunt trauma to right side, advanced decomposition
5/13/92	serious injury	fishery interaction	"Strait" sex unknown, juvenile born 1991	42° 26' 70° 21'	gillnet line through mouth and around flipper, mouth lines anchored to bottom, animal worn out and in peril, open wounds on tail, disentangled
8/3/92	serious injury	fishery interaction	unknown	42° 16' 70° 05'	orange mesh netting and line wrapped over head and back with about 15-20' trailing, animal moving slowly and not fluking
8/9/92	serious injury	fishery interaction	length (est.) = 13 m	44° 16' 68° 03'	monofilament net and poly lines across back and one flipper; gear may be trailing but not seen; bleeding, abrasions, labored breathing
9/17/92	serious injury	fishery interaction	length (est.) = 13 m	43° 09' 70° 09'	1/2", 3-strand grey poly line w poly ball; poly ball removed; breathing labored
9/26/92	serious injury	fishery interaction	length (est.) = 8 - 10 m	41° 00' 71° 50'	monofilament gillnet w/ 5/8" poly lines; mesh visible; gear wrapped around head, flippers, and bunched at tail region; labored breathing and trumpeting
10/8/92	serious injury	fishery interaction	estimated to be adult size	41° 08' 69° 11'	lobster or longline gear w/large orange buoy; whale entangled at dorsal fin; breathing labored
10/9/92	mortality	vessel collision	8.7 m female	Metompkin Island, Acomac, Virginia	fresh dead; external bruising and hemorrhage; boat collision
10/22/92	mortality	fishery interaction	unknown	36° 46' 75° 57'	line entanglement scars and cuts on leading edge of fluke and around caudal peduncle

Date	Report type	Assigned cause	Photo ID, Sex/age	Location	Notes
4/22/93	serious injury	fishery interaction	age and sex unknown	42° 01' 70° 06'	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	fishery interaction	age estimated 2-3 y.o.	42° 26' 70° 27'	buoy warp wrapped around base of flipper; anchored and very fatigued; whale freed itself; unknown whether carrying gear
7/26/93	serious injury	fishery interaction	unknown	44° 00' 67° 38'	entangled; line wrapped around head and behind blowhole
8/8/93	serious injury	fishery interaction	unknown	44° 17' 68° 00'	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	vessel collision	unknown	Atlantic City, New Jersey	boat collision with 33 ‘ sport fishing vessel; extent of injuries undetermined
7/14/94	serious injury	fishery interaction	unknown	43° 23' 68° 59'	CG helicopter crew reported animal with gillnet wrapped around head and swimming at surface
2/28/95	mortality	fishery interaction	unknown	35° 17' 75° 31'	stranded dead with gear wrapped around tail region
5/26/95	serious injury	fishery interaction	length (est.) = 10 m	41° 16' 69° 20'	net and monofilament around tail region; whale anchored; mesh visible and gear trailing
6/4/95	mortality	vessel collision	8.9 m male	Virginia Beach, Virginia	floater off inlet; lacerations along peduncle, probable ship strike
4/2/96	mortality	vessel collision	7.2 m female	Cape Story, Virginia Beach, Virginia	fresh dead; fractured left mandible; emaciated
5/9/96	mortality	vessel collision	6.7 m female	mouth of Delaware Bay	propeller cuts behind blowhole, moderate decomposition; ship strike

Table notes:

1.The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was reported beached, entangled, or injured. 2.

National guidelines for determining what constitutes a serious injury have not been established. 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 in the vicinity of Cape Cod Bay and Nantucket sound. 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. While researchers often tend to attribute strikes to large vessels, the record of 7 October 1993 off Atlantic City, NJ, reports a collision (and subsequent injury) with a 33 ft sport-fishing vessel. 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.

While entangled animals are often released, on the other hand, some dead or injured animals likely go unobserved and unreported. 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

The size of this stock is considered to be low relative to OSP in the U.S. Atlantic EEZ, and this species is listed as endangered under the ESA. A Recovery Plan has been published and is in effect (NMFS 1991). There are insufficient data to determine the population trends for humpback whales. The annual rate of population increase was estimated at 9% (Katona and Beard 1990), but the lower 95% confidence level was less than zero. The total level of human-caused mortality and serious injury is unknown, but current data indicate that it is significant. 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 humpback whale is listed as an endangered species under the ESA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Scientific Committee of the International Whaling Commission (IWC) has proposed stock boundaries for North Atlantic fin whales. Fin whales off the eastern U.S., north to Nova Scotia and on to the southeast coast of Newfoundland are believed to constitute a single stock under the present IWC scheme (Donovan 1991). However, the stock identity of North Atlantic fin whales has received relatively little attention, and whether the current stock boundaries define biologically isolated units is uncertain. The existence of a subpopulation structure was suggested by local depletions that resulted from commercial over harvesting (Mizroch *et al*. 1984). Confirmation or revision of existing proposed stock boundaries awaits input from techniques such as molecular genetics or telemetry.

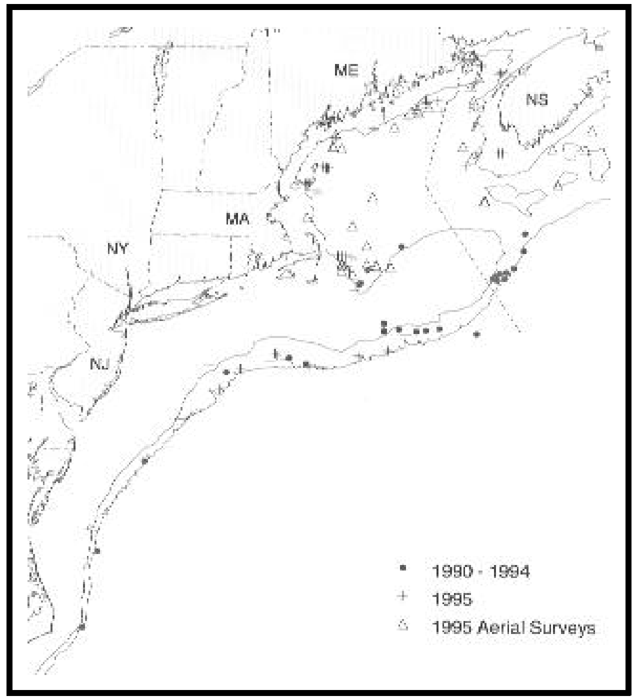

Figure 1. *Distribution of fin whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

Fin whales are common in waters of the U.S. 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 cetacean species in all seasons, with the largest standing stock, the largest food requirements, and therefore the largest impact on the ecosystem of any cetacean species (Hain *et al*. 1992).

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

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

POPULATION SIZE

Four seasonal abundance estimates for fin whales are available for portions of the northeastern U.S. Atlantic during spring and summer of 1978-82, June-July 1991, August-September 1991, and August-September 1991 and 1992 (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 were chosen because the greatest proportion of the population off the northeast U.S. 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, in prep.). 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, an estimate of g(0), probability of detecting a group on the track line, but no correction for dive-time. Variability was estimated using bootstrap resampling techniques.

The best available current abundance estimate for the western North Atlantic fin whale is 2,700 (CV=0.59) from the 1991-92 northern Gulf of Maine-lower Bay of Fundy line transect surveys because it is relatively recent and covers the largest portion of the known habitat.

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

* 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 2,700 (CV=0.59). The minimum population estimate for the western North Atlantic fin whale is 1,704 (CV=0.59).

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 (Wade and Angliss 1997). The minimum population size is 1,704 (CV=0.59). 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 3.4.

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 1991-95. There are a relatively small number of records of fin whales impacted by fishery interaction/entanglement or vessel collisions.

Fishery Information

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

A review of 13 records of stranded or floating (dead or injured) fin whales for the period 1992-1995 on file at NER/NMFS showed that three had fishery interactions: two had net or rope marks, and one had line through the mouth and around the tail.

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

Other Mortality

Of 18 fin whale records from the period 1991-1995 in the Smithsonian Institution's Marine Mammal database, there are four records with ship collision, boat strike, and/or propeller scars noted. Whether these constituted serious injury or were the proximal cause of the mortality in every instance is unknown. It does suggest that ship strikes do occur on fin whales. This is a small number of individuals relative to the size of the population. For both types of human impacts (ship strikes or net entanglement), carcasses in advanced decomposition, unrecovered, and/or not necropsied represent 'lost data'.

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. 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. 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*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Indications are that, at least during the feeding season, the sei whale population is centered in northerly waters, perhaps on the Scotian Shelf (Mitchell and Chapman 1977). The southern portion of the species' range during spring and summer includes the northern portions of the U.S. Atlantic Exclusive Economic Zone (EEZ) — the Gulf of Maine and Georges Bank. The period of greatest abundance there is in spring, with sightings concentrated along the eastern margin of Georges Bank and into the Northeast Channel area, and along the southwestern edge of Georges Bank in the area of Hydrographer Canyon (CeTAP 1982). The sei whale is generally found in the deeper waters characteristic of the continental shelf edge region (Hain *et al*. 1985). Mitchell (1975) similarly reported that sei whales off Nova Scotia were often distributed closer to the 2,000 m depth contour than were fin whales.

This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters. The sei whale, like the right whale, is largely planktivorous — feeding primarily on euphausiids and copepods. In years of reduced predation on copepods by other predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the Great South Channel and Stellwagen Bank areas (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*. 1992).

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

Mitchell and Chapman (1977) reviewed the sparse evidence on stock identity of northwest Atlantic sei whales, and suggested two stocks — a Nova Scotia stock and a Labrador Sea stock. The Nova Scotian stock includes the continental shelf waters of the northeastern U.S., and extends northeastward to south of Newfoundland. The Scientific Committee of the IWC, while adopting these general boundaries, noted that the stock identity of sei whales (and indeed all North Atlantic whales) was a major research problem (Donovan 1991). In the absence of evidence to the contrary, the proposed IWC stock definition is provisionally adopted.

POPULATION SIZE

The total number of sei whales in the U.S. 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 U.S. 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 U.S. 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. 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 western North Atlantic sei whale. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV). Unk=Unknown.

Month/Year	Area	N_{best}	CV
1966 - 1972	Nova Scotia, Canada	1,393 to 2,248	Unk
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 (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 western North Atlantic 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 1991-1995. 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 U.S. 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 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. This is a strategic stock because the sei 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 is very little data from the Canadian east coast population.

Minke whales off the eastern coast of the United States are considered to be part of the Canadian east coast population, which inhabits the area from the eastern half of 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.

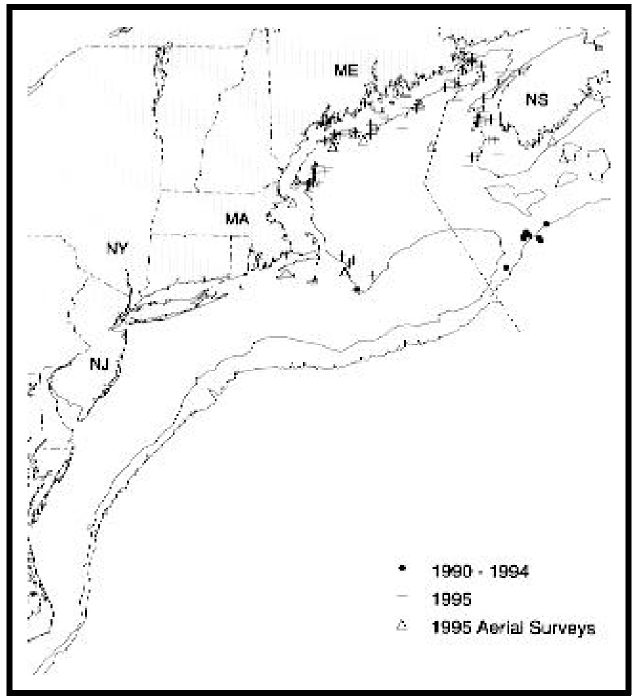

Figure 1. *Distribution of minke whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

The minke whale is the third most abundant large whale in the U.S. Atlantic Exclusive Economic Zone (EEZ). It is common and widely distributed (CeTAP 1982). 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.

POPULATION SIZE

The total number of minke whales in the Canadian East Coast population is unknown. However, three estimates are available for portions of the habitat — a 1978-1982 estimate (CeTAP 1982), a shipboard survey estimate from the summers of 1991 and 1992, and a shipboard estimate from June-July 1993 (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 U.S. 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. 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, an estimate of g(0), 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 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 resampling techniques.

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 2,650 (CV=0.31) as estimated from the July to September 1991 and 1992 shipboard line transect surveys because this survey is fairly 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

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 2,650 (CV=0.31). The minimum population estimate for Canadian East Coast minke whale is 2,053 (CV=0.31).

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 (Wade and Angliss 1997). The minimum population size is 2,053 (CV=0.31). 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

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 takes have been observed in U.S. waters in the Japanese tuna longline, New England sink gillnet, Atlantic drift gillnet, bluefin tuna purse seine fisheries, and in fish traps and fish weirs; though all takes have not resulted in a mortality. A minke whale was caught and released in the Japanese tuna longline fishery in 3,000 m of water, south of Lydonia Canyon on Georges Bank, in September 1986 (Waring *et al.* 1990). Two minke whales were taken in the New England sink gillnet fishery. The take in July 1991, south of Penobscot Bay, Maine resulted in a mortality (Table 2), and the take in October 1992, off the coast of New Hampshire near Jeffreys Ledge was released alive. Four minke whale mortalities were observed in the pelagic drift gillnet fishery during 1995 (Table 2). One minke whale was reported caught in a bluefin tuna purse seine off Stellwagen Bank in 1991 and released uninjured .(D. Beach, NMFS NE Regional Office, pers. comm.). Read (1994) reported that a minke whale was found dead in a Rhode Island fish trap in 1976, and that a minke whale was trapped and released alive in a herring weir off northern Maine in 1990.

In U.S. waters, an entanglement database maintained by NE Regional Office for 1975-1992 includes 36 records of minke whales. The gear includes unspecified fishing net, unspecified cable or line, fish trap, weirs, seines, gillnets, and lobster gear. A review of these records is not complete, but preliminary summaries are reported below. An immature female minke whale, entangled with line around the tail stock, came ashore on the Jacksonville, Florida, jetty on 31 January 1990, and on 15 March 1992, a juvenile female minke whale with propeller scars was found floating east of the St. Johns channel entrance (R. Bonde, USFWS, Gainesville, FL, pers. comm.). The 1997 List of Fisheries (62FR33, January 2, 1997) reported seven minke whale mortalities and serious injuries have been attributed to the lobster fishery during 1990 to 1994.

In Canadian waters, information about minke whale interactions with fishing gear is not well quantified or recorded in most parts of Canada, though some records are available. The following were reported in Read (1994). Six minke whales were reported entangled in gillnets in Newfoundland and Labrador during 1989. One of these animals escaped towing gear, the rest died. Five minke whales were entrapped and died in Newfoundland cod traps during 1989. During 1980 and 1990, 15 of 17 minke whales were released alive from herring weirs in the Bay of Fundy. In 1990, ten minke whales were trapped in the Bay of Fundy weirs, but all were released alive. Due to the formation of a cooperative program between Canadian fishermen and biologists it is expected that in the future more minke whales will be able to be released alive (A. Westgate, pers. comm.). Salmon gillnets in Canada have taken a few minke whales. In Newfoundland in 1979, one minke whale died in a salmon net. Between 1979 and 1990, it was estimated that 15% of the minke whale takes were in salmon gillnets.

Accurate estimates of human-caused mortality are not available because it is likely that many entanglements, injuries, and mortalities go unobserved and/or unrecorded, and existing data are fragmentary. Total annual estimated average fishery-related mortality and serious injury to this stock in the Atlantic in fisheries observed by NMFS during 1990-1995 was 2.5 minke whales (CV = 0.97), though the total from all fisheries is unknown. After U.S. stranding records are audited an updated mortality and serious injury estimate will be made.

Fishery Information

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 provides observer coverage of vessels fishing south of Cape Hatteras.

As described, minke whale takes have been observed in U.S. waters in the Japanese tuna longline, New England sink gillnet, Atlantic drift gillnet, bluefin tuna purse seine fisheries, and in fish traps and fish weirs; though all takes have not resulted in a mortality.

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

There are approximately 349 vessels (full and part time) in the New England multispecies sink gillnet fishery (Walden 1996). Observer coverage in trips has been 1%, 6%, 7%, 5%, 7% and 5% for years 1990 to 1995 (Table 2). The fishery has been observed in the Gulf of Maine and in Southern New England. One mortality was observed in this fishery in 1991. Estimated fishery-related mortality and serious injury attributable to this fishery was ten minke whales (CV = 0.97) in 1991 (Northridge 1996). Annual estimated average fishery-related mortality and serious injury to this stock in the Atlantic during 1990-1995 attributable to the New England sink gillnet fishery was 1.7 minke whales (CV = 0.97) (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 and 1995 were 233, 243, 232, 197 and 164 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994 and 1995 there were 12 and 11 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 and 99% in 1995 (Table 2). 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. Minke whales were caught in this fishery only in 1995. 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 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 and 4 (0) for 1995; estimated average annual mortality and serious injury related to this fishery during 1991-1995 was 0.8 minke whales (CV=0.00).

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

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

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

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

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
New England Multispecies Sink Gillnet	90-95	349	Obs. Data Weighout	.01, .06, .07, .05, .07, .05	0, 1, 0, 0, 0, 0	0, 10, 0, 0, 0, 0	0, .97, 0, 0, 0, 0	1.7 (.97)
Pelagic Drift Gillnet[3]	91-95	1994=12[4] 1995=11	Obs. Data Logbook	.20, .40, .42, .87, .99	0, 0, 0, 0, 4	0, 0, 0, 0, 4.0 [5]	0	0.8 (0)
TOTAL								2.5 (.97)

[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 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] The observer coverage for the sink gillnet fishery is the number of trips, and for the pelagic drift gillnet fishery the unit of effort is a set.

[3] 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 (Bisack, in prep.).

[4] 1994 and 1995 shown, other years not available on an annual basis.

[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 Sea Sampling 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.

Other Mortality

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

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

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

STATUS OF STOCK

The status of minke whales, relative to OSP, in the U.S. Atlantic EEZ is unknown. The minke whale is not listed as endangered under the Endangered Species Act (ESA). In Canada, the Cetacean Protection Regulations of 1982, promulgated under the standing Fisheries Act, prohibit the catching or harassment of all species of cetaceans. 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 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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BLUE WHALE (*Balaenoptera musculus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

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

POPULATION SIZE

Little is known 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). 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.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are 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 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 records of fishery-related mortality or serious injury to blue whales in the U.S. Atlantic 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 U.S. 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. This is a strategic stock because the blue whale is listed as an endangered species under the ESA.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of the sperm whale in the U.S. 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 U.S. EEZ likely represent only a fraction of the total stock. The nature of linkages of the U.S. 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 U.S., 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. There exists one tag return of a male tagged off Browns Bank (Nova Scotia) in 1966 and returned from Spain in 1973.

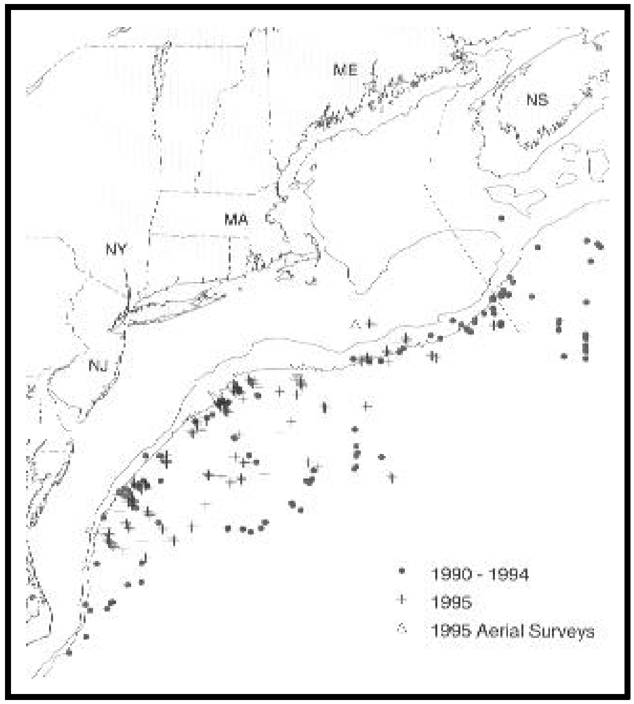

Figure 1. *Distribution of sperm whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

In the U.S. 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 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. 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 U.S. 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 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 U.S. 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=0.36) 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). 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; Palka and Waring, in prep.). 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 U.S. 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 (Palka and Waring, in prep.) because this survey is recent and provided the most complete coverage of continental shelf edge and continental slope waters off the northeast U.S. 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	0.36
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 3-4 years, lactation period is 24 months, gestation period is 14.5-16.5 months, births occur mainly in July to November, length at birth is 405 cm, length at sexual maturity 11.0-12.0 m for males, and 8.3-9.2 m for females, mean age at sexual maturity is 19 years for males and 9 years for females, and mean age at physical maturity is 45 years for males and 30 years for females (Best 1974; Lockyer 1981).

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 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 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.

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.

There were no observed sperm whale mortalities in the U.S. Exclusive Economic Zone (EEZ) during 1991-1995. There is no information on incidental mortality in fisheries in Canadian waters.

Fishery Information

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 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.

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 and 1995 were 233, 243, 232, 197 and 164 respectively. Fifty-nine vessels participated in this fishery between 1989 and 1993. In 1995 there were 11 vessels 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 and 99% in 1995. 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 and 0 in 1995. Estimated average annual mortality and serious injury related to this fishery during 1991-1995 was zero, assuming the 1995 injured sperm whale was not a serious injury. The 1991-1995 time period provides a better characterization of the current fishery. 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	Uninjured
Pelagic Drift Gillnet	91-95	0, 0, 0, 0, 0	0, 0, 0, 0, 1[1]	0, 0, 0, 0, 0

[1] The observer recorded this animal being released alive and having the "gear in/around several body parts".

STATUS OF STOCK

The status of this stock relative to OSP in U.S. 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*) and the pygmy sperm whale (*K. breviceps*) appear 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; NMFS unpublished data). Pygmy sperm whales and dwarf sperm whales are difficult to distinguish and sightings of either species are often categorized as *Kogia* spp. There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

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

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.

Fisheries Information

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory logbook system for large pelagic fisheries. 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.

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 1991-1995 was 0.2 dwarf sperm whales (CV = 0) (Table 1). The 1991-1995 time period provides a better characterization of the current fishery.

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	91-95	1994=12 1994=11	Obs. Data Logbook	.20, .40, .42, .87, .99	0, 0, 0, 0, 1	0, 0, 0, 0, 1.0 [5]	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] 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 (Bisack, in prep.).

[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 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

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

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. 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. Upon the advice of the Atlantic Scientific Review Group this stock has been designated a strategic stock because PBR cannot been determined and there is an unknown amount of possible human-caused mortality from the ingestion of marine debris such as plastic bags and from possible boat strikes.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The dwarf sperm whale (*Kogia breviceps*) and the pygmy sperm whale (*K. simus*) appear to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 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 unpublished data). Pygmy sperm whales and dwarf sperm whales are difficult to distinguish and sightings of either species are often categorized as *Kogia* spp. There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

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

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 U.S. Atlantic EEZ is unknown. Available information indicates there is likely little, if any, fisheries interaction with pygmy sperm whales in the U.S. Atlantic EEZ.

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

Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Data on current incidental takes in U.S. 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

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

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. 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. Upon the advice of the Atlantic Scientific Review Group this stock has been designated a strategic stock because PBR cannot been determined and there is an unknown amount of possible human-caused mortality from the ingestion of marine debris such as plastic bags and from possible boat strikes.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

POPULATION SIZE

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

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04 for purposes of this assessment. This value is based on theoretical calculations showing that cetacean populations may not generally grow at rates much greater than 4% given the constraints of their reproductive life history (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. PBR for the western North Atlantic killer whale is unknown because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY

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

Fishery Information

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 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.

STATUS OF STOCK

The status of killer whales relative to OSP in U.S. Atlantic EEZ is unknown. Because there are no observed mortalities or serious injury between 1990 and 1995, the total fishery-related mortality and serious injury for this stock is considered insignificant and approaching zero mortality and serious injury rate. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. This is not a strategic stock because, although PBR could not be calculated, there is no evidence of human-induced mortality.

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July 1995

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

POPULATION SIZE

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

Minimum Population Estimate

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

Current Population Trend

No information was available to evaluate trends in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are 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 six (6). 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 killer whale is 0.1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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

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

Fisheries Information

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 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

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

STATUS OF STOCK

The status of pygmy killer whales relative to OSP in U.S. Atlantic 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 known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The western North Atlantic pygmy killer whale is considered a non-strategic stock.

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July 1995

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Northern bottlenose whales are characterized as extremely uncommon or rare in waters of the U.S. Atlantic Exclusive Economic Zone. The two sightings of three individuals constituted less than 0.1% of the 11,156 cetacean sightings in the 1978-82 CeTAP surveys. Both sightings were in the spring, along the 2,000 m isobath (CeTAP 1982). In 1993 and 1996, two sightings of single animals, and in 1996, a single sighting of six animals (one juvenile), were made during summer shipboard surveys conducted along the southern edge of Georges Bank (Anon. 1993; Anon. 1996).

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

There are two main centers of bottlenose whale distribution in the western north Atlantic, one in the area called "The Gully" just north of Sable Island, Nova Scotia, and the other in Davis Strait off northern Labrador (Reeves *et al*. 1993). Studies at the entrance to the Gully from 1988-1995 identified 237 individuals and estimated the local population size at about 230 animals (95% C.I. 160-360) (Whitehead *et al*. 1997). Mitchell and Kozicki (1975) documented stranding records in the Bay of Fundy and as far south as Rhode Island. Stock definition is unknown.

POPULATION SIZE

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

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are 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 northern bottlenose whale is unknown because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY

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

Fishery Information

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 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.

STATUS OF STOCK

The status of northern bottlenose whales relative to OSP in U.S. Atlantic EEZ is unknown; however, a depletion in Canadian waters in the 1970s may have impacted U.S. distribution and may be relevant to current status in U.S. waters. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. Because there are no observed mortalities or serious injury, the total fishery-related mortality and serious injury for this stock is considered insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because there are no recent records of fishery-related mortality or serious injury.

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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 U.S. coast south to Florida, around the Gulf of Mexico, and within the Caribbean (Leatherwood *et al*. 1976; CeTAP 1982; Heyning 1989; Houston 1990). Stock structure in the western North Atlantic is unknown.

Cuvier's beaked whale sightings have occurred principally along the continental shelf edge in the mid-Atlantic region off the northeast U.S. coast (CeTAP 1982; Waring *et al*. 1992; Palka and Waring, in prep.). Most sightings were in late spring or summer. Based on sighting data, this species is a rare inhabitant of waters off the northeast U.S. coast (CeTAP 1982).

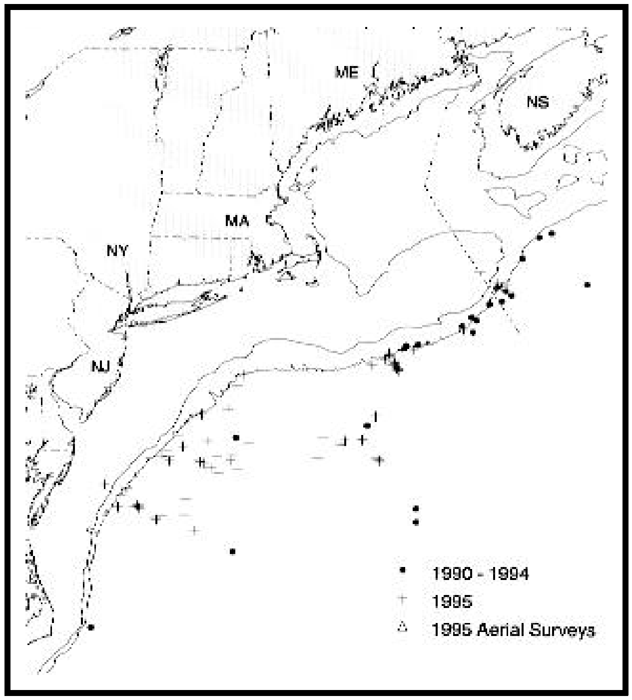

Figure 1. *Distribution of beaked whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

The total number of Cuvier's beaked whales off the eastern U.S. 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 U.S. 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.

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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; Palka and Waring, in prep.). 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 (Palka and Waring, in prep.) 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 (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

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

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic Exclusive Economic Zone (EEZ) might have been subject to the observed fishery-related mortality and serious injury. Thirty-five fishery-related beaked whale mortalities were observed in the pelagic drift gillnet fishery between 1989 and 1995. The 1991-1995 total average estimated annual fishery-related mortality of beaked whales in the U.S. EEZ was 9.7 (CV = 0.08) (Table 2). The 1991-1995 period provides a better characterization of the current pelagic drift gillnet fishery.

Fisheries Information

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

Current data on 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 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 U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

By-catch has been observed by NMFS Sea Samplers in the 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 and 1995 were 233, 243, 232, 197 and 164 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994 and1995, respectively, there were 12 and 11 vessels 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 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. 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 (Bisack, in prep.). 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 1995. 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), and 9.1 in 1995 (0) (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 of Cuvier's beaked whale (*Ziphius cavirostris*), and *Mesoplodont* 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	91-95	1994=12 1995=11	Obs. Data Logbook	.20, .40, .42, .87, .99	3, 1, 5, 4, 9	13, 9.7, 12, 4.8, 9.1[5]	.21, .24, .16, .08, 0	9.7 (.08)
TOTAL								9.7 (.08)

[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. 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). In 1994 and 1995, observer coverage increased substantially, and bycatch rates were not pooled for this period (Bisack, in prep).
[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.

Table 3. Summary of Cuvier's Beak Whales (*Ziphius cavirostris*) 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
Pelagic Drift Gillnet	91-95	3/13, 1/9.7, 5/12, 4/4.8, 9/9.1	0, 0, 0, 0, 1 [1]	0, 0, 0, 0, 0

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

Other Mortality

From 1992-1995, 5 beaked whales (3-Gervais's beaked whales; 1-Ture's beaked whale; 1-Cuvier's beaked whale) stranded between North Carolina and New Jersey (NMFS unpublished data).

STATUS OF STOCK

The status of Cuvier's beaked whale relative to OSP in U.S. 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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MESOPLODONT 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). Off the northeast U.S. coast, beaked whale (*Mesoplodon* spp.) sightings have occurred principally along the southern edge of Georges Bank (CeTAP, 1982; Waring *et al*. 1992; Palka and Waring, in prep.). 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; Palka and Waring, in prep.).

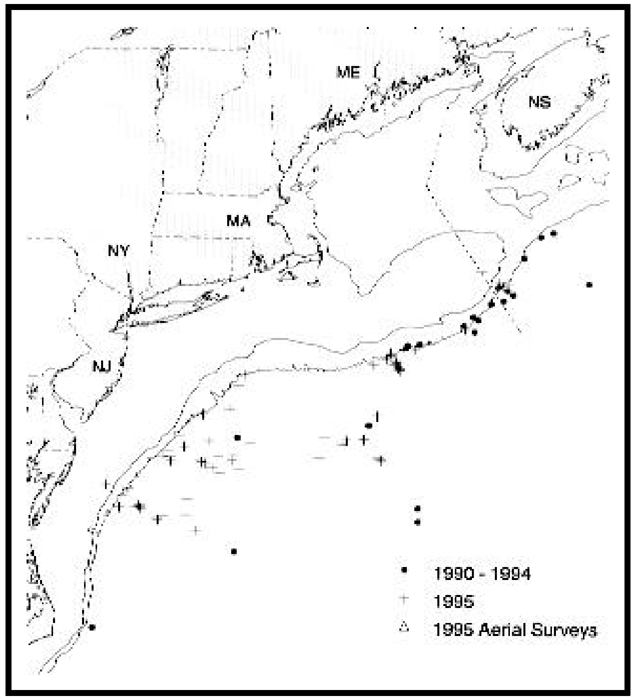

Figure 1. *Distribution of beaked whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

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 U.S. 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 U.S. 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 U.S. 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.

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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.

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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 U.S. 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 (Palka and Waring, in prep) 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 undifferentiate complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 895 (CV=0.69). It is not possible to determine the minimum populatin 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 (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 Mosoplodont beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic Exclusive Economic Zone (EEZ) might have been subject to the observed fishery-related mortality and serious injury. Thirty-five fishery-related beaked whale mortalities were observed in the pelagic drift gillnet fishery between 1989 and 1995. The 1991-1995 total average estimated annual fishery-related mortality of beaked whales in the U.S. EEZ was 9.7 (CV = 0.08). The 1991-1995 period provides a better characterization of the current pelagic drift gillnet fishery (Table 2).

Fisheries Information

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

Current data on 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 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 U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

By-catch has been observed by NMFS Sea Samplers in the 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 and 1995 were 233, 243, 232, 197 and 164 respectively. Fifty-nine different vessels participated in this 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 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 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. 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 (Bisack, in prep.). 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 1995. 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) and 9.1 in 1995 (0). The 1991-1995 average estimated annual fishery-related mortality of beaked whales was 9.7 (0.08) (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 of Cuvier's beaked whale (*Ziphius cavirostris*), and *Mesoplodont* 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	91-95	1994=12 1995=11	Obs. Data Logbook	.20, .40, .42, .87, .99	3, 1, 5, 4, 9	13, 9.7, 12, 4.8, 9.1[5]	.21, .24, .16, .08, 0	9.7 (.08)
TOTAL								9.7 (.08)

[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. 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). In 1994 and 1995, observer coverage increased substantially, and bycatch rates were not pooled for this period (Bisack, in prep).

[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.

Table 3. Summary of Cuvier's beaked whales (*Ziphius cavirostris*) and Mesoplodont 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	Uninjured
Pelagic Drift Gillnet	91-95	3/13, 1/9.7, 5/12, 4/4.8, 9/9.1	0, 0, 0, 0, 1 [1]	0, 0, 0, 0, 0

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

Other Mortality

From 1992-1995, 5 beaked whales (3-Gervais's beaked whales; 1-Ture's beaked whale; 1-Cuvier's beaked whale) stranded between North Carolina and New Jersey (NMFS unpublished data).

STATUS OF STOCK

The status of Mesoplodont beaked whales relative to OSP in U.S. Atlantic EEZ is unknown. These species are not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine 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 U.S. coast, Risso's dolphin is distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank during the spring, summer, and autumn (CeTAP 1982; Payne *et al*. 1984). In winter, the range begins at the mid-Atlantic bight and extends further into oceanic waters (Payne *et al*. 1984). In general, the population 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 U.S. 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 U.S. 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.

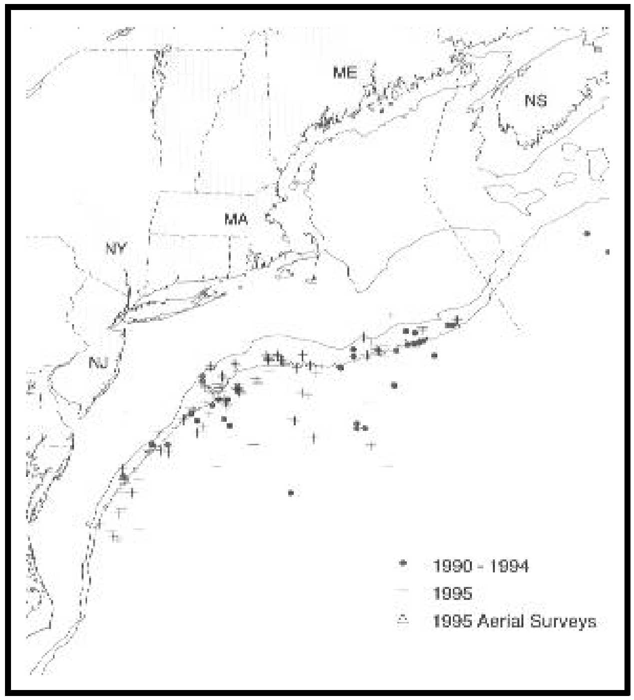

Figure 1. *Distribution of Risso's dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

A population size of 11,017 (CV=0.58)[1] 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). Data were collected by one team that searched by naked

[1]In June 1997, a coding error was found in the 1991 shipboard data file which impacted the stratification component of the DISTANCE analysis. The revised value reflects this correction, it does not represent a new analysis of the 1991 survey data. This error occurred in the analysis of pilot whales, common dolphins, Risso's dolphins and offshore bottlenose dolphins. The revised numbers **have not** been reviewed by the Atlantic Scientific Review Group or the Atlantic Offshore Take Reduction Team. Details are contained in G. Waring, Memo to The Record, August 1997.

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).

Although the 1991 and 1993 surveys did not sample exactly the same areas or encompass the entire Risso's dolphin habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective data suggest that at least several thousand Risso's dolphins occupy these waters seasonally; however, survey coverage to date was not judged adequate to provide a definitive estimate of Risso's dolphin abundance in the western North Atlantic.

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, 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	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

* 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 (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 0.5 because this stock is of unknown status. PBR for the western North Atlantic Risso's dolphin is 111.

ANNUAL HUMAN-CAUSED MORTALITY

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

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

Fisheries Information

Prior to 1977, there was no documentation of marine mammal by-catch in distant-water fleet (DWF) activities off the northeast coast of the U.S. With implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA) in that year, an observer program was established which has recorded fishery data and information of incidental by-catch of marine mammals. DWF effort in the U.S. Atlantic Exclusive Economic Zone (EEZ) under MFCMA has been directed primarily towards Atlantic mackerel and squid. From 1977 through 1982, an average of 120 different foreign vessels per year (range 102-161) operated within the U.S. Atlantic EEZ. In 1982, there were 112 different foreign vessels; 16%, or 18, were Japanese tuna longline vessels operating along the U.S. east coast. This was the first year that the Northeast Regional Observer Program assumed responsibility for observer coverage of the longline vessels. Between 1983 and 1991, the numbers of foreign vessels operating within U.S. Atlantic EEZ each year were 67, 52, 62, 33, 27, 26, 14, 13, and 9, respectively. Between 1983 and 1988, the numbers of DWF vessels included 3, 5, 7, 6, 8, and 8, respectively, Japanese longline vessels. Observer coverage on DWF vessels was 25-35% during 1977-82, and increased to 58%, 86%, 95%, and 98%, respectively, in 1983-86. From 1987-91, 100% observer coverage was maintained. Foreign fishing operations for squid and mackerel ceased at the end of the 1986 and 1991 fishing seasons, respectively. NMFS foreign-fishery observers have reported four deaths of Risso's dolphins incidental to squid and mackerel fishing activities in the continental shelf and continental slope waters between March 1977 and December 1991 (Waring *et al*. 1990; NMFS unpublished data). Three animals were taken by squid trawlers and a single animal was killed in longline fishing operations.

Data on 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 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, 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, and 42% in 1993. Effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras. Examination of the species composition of the catch and locations of the fishery throughout the year, suggested that the 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, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). Thirty seven Risso's dolphin mortalities were observed between 1989 and 1993. One animal was entangled and released alive. By-catch occurred during July, September and October along continental shelf edge canyons off the southern New England coast. Estimated annual mortality and serious injury (CV in parentheses) attributable to the drift gillnet fishery was 87 in 1989 (0.52), 144 in 1990 (0.46), 21 in 1991 (0.55), 31 in 1992 (0.27), and 14 in 1993 (0.42); average annual mortality and serious injury during 1989-1993 was 59 (0.61).

During the period 1989 to 1993, effort in the pelagic pair trawl fishery has increased, from zero hauls in 1989 and 1990, to an estimated 171 hauls in 1991 and then to an estimated 989 and 1087 hauls in 1992 and 1993 respectively. The fishery operated from August to November in 1991, from June to November in 1992, and from June to October in 1993. Sea sampling began in October of 1992 where 101 sets (10% of the total) were sampled. In 1993, 201 hauls (18% of the total) were sampled. Nineteen vessels have operated in this fishery. The fishery extends from 35°N to 41°N, and from 69°W to 72°W. Approximately 50% of the total effort was in a one degree square at 39°N, 72°W, around Hudson Canyon. Examination of the locations and species composition of the by-catch, showed little seasonal change for the 6 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 mortality and serious injury (CV in parentheses) to Risso's dolphins in the pelagic pair trawl fishery was 0.6 in 1991 (1.0), 4.3 in 1992 (0.76) and 3.2 in 1993 (1.0); average annual mortality and serious injury during 1991-1993 was 2.7 (0.98).

Total effort for the pelagic longline fishery, based on mandatory self-reported fisheries information, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). The fishery has been observed from January to March off Cape Hatteras, in May and June in the entire Mid-Atlantic, and in July through December in the Mid-Atlantic Bight and off Nova Scotia. This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. One Risso's dolphin mortality was observed in 1993, producing an estimated total longline fishery-related mortality of 13 Risso's dolphins (CV = 0.19) for 1993, and a 1992-1993 estimated annual average of 6.5 (CV = 0.27).

STATUS OF STOCK

The status of Risso's dolphins relative to OSP in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. The 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 1990-93 average annual fishery-related mortality did 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* spp., and is identified as such. The species boundary is considered to be in the New Jersey to Cape Hatteras area. Sightings north of this area are likely *G. melas*.

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

The long-finned pilot whale is distributed from North Carolina to Iceland and possibly the Baltic Sea (Sergeant 1962; Leatherwood *et al*. 1976; Abend 1993). The stock structure of the North Atlantic population is currently unknown (Anon. 1993); however, several recently initiated genetic studies and proposed North Atlantic sighting surveys will likely provide information required to delineate stock boundaries.

POPULATION SIZE

The total number of long-finned pilot whales off the eastern U.S. and Canadian Atlantic coast is unknown, 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 U.S. 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* spp., both long-finned and short-finned pilot whales.

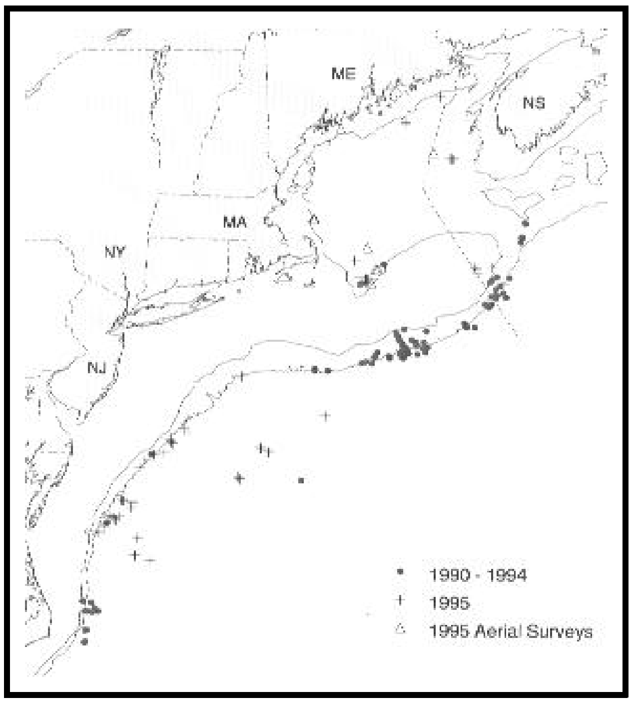

Figure 1. *Distribution of pilot whale sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

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.

A population size of 11,120 (CV=0.29) *Globicephala* spp. 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 U.S. 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* spp. 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 4,110 (CV = 0.35)[2] Globicephala spp. 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 3,668 (CV=0.28) and 5,377 (CV=0.53) *Globicephala* spp. 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* spp. 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* spp. was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; Palka and Waring, in prep.). 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 U.S. 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.

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[2]In June 1997, a coding error was found in the 1991 shipboard data file which impacted the stratification component of the DISTANCE analysis. The revised value reflects this correction, it does not represent a new analysis of the 1991 survey data. This error occurred in the analysis of pilot whales, common dolphins, Risso's dolphins and offshore bottlenose dolphins. The revised numbers **have not** been reviewed by the Atlantic Scientific Review Group or the Atlantic Offshore Take Reduction Team. Details are contained in G. Waring, Memo to The Record, August 1997.

The best available current abundance estimate for *Globicephala* spp. is 8,176 (CV=0.65) as estimated from the July to September 1995 line transect survey (Palka and Waring, in prep.) 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* spp. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV). Unk=unknown.

Month/Year	Area	N_{best}	CV
1951-1961	Newfoundland	50,000	unk
1951-1961	Newfoundland	50,000-60,000	unk
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	4,110	0.35
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* spp. is 8,176 (CV=0.65). The minimum population estimate for *Globicephala* spp. 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 (Wade and Angliss 1997). The minimum population size for *Globicephala* spp. 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 0.5 because this stock is of unknown status. PBR for the western North Atlantic *Globicephala* spp. is 50.

ANNUAL HUMAN-CAUSED 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.

Foreign fishery observers documented 436 pilot whale mortalities in Atlantic mackerel and squid fisheries (Waring *et al*. 1990; Waring 1995). Between 1989 and 1995, sixty -eight mortalities were observed in the large pelagic drift gillnet fishery, twenty-nine in the pelagic pair trawl fishery (1989-1995), and one each in the pelagic longline and groundfish trawl fisheries (NMFS unpublished data; see below). Although only one mortality has been observed in the U.S. large pelagic longline fishery, 24 pilot whales were released alive, two injured, after becoming entangled or hooked in this gear. Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). One mortality was observed in New England groundfish trawl fisheries in 1990 and one released alive and uninjured in 1993. Two were released alive and injured in 1992 and 1993 in the pelagic drift gillnet fishery. There were no takes in the New England multispecies sink gillnet fishery. An unknown number of pilot whales have also been taken in Newfoundland and Labrador, and Bay of Fundy, groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, and Atlantic Canada cod traps (Read 1994).

Total fishery-related mortality and serious injury cannot be estimated separately for the two species of pilot whales in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury. Total estimated annual fishery-related mortality of pilot whales from NMFS-observed fisheries was the sum of integer-rounded annual mortality estimates across the pelagic longline (1992-1993), pelagic drift gillnet (1991-1995), pelagic pair trawl (1992-1995), and North Atlantic trawl fisheries (1991-1995) and was 42 pilot whales, *Globicephala* spp. (CV = 0.11) (Table 2).

Fisheries Information

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

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

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

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

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

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

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory 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 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 and 1995 were 233, 243, 232, 197 and 164 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1995 there were 11 vessels 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 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. 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 (Bisack, in prep.). 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), and 9.1 in 1995 (0); average annual mortality between 1991-1995 was 24.6 pilot whales (0.09) (Table 2). The 1991-1995 period provides a better characterization of this fishery (i.e., fewer vessels and increased 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. Because animals released alive may have subsequently died due to injuries received during entanglement, pilot whales that were released were included in the mortality estimates. Pilot whales were taken along the continental shelf edge, northeast of Cape

Hatteras in January and February. Takes were recorded at the continental shelf edge east of Cape Charles, Virginia, in June. Pilot whales were taken from Hydrographer Canyon along the Great South Channel to Georges Bank from July-November. Takes occurred at the Oceanographer Canyon continental shelf break and along the continental shelf northeast of Cape Hatteras in October-November.

Effort in the 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. 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, 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* spp.) mortalities were reported in the self-reported fisheries information in 1993. In 1994 and 1995 observers reported one and twelve mortalities, respectively (Table 2). The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery in 1994 was 2.0 (CV=0.49) and 22 (CV=0.33) in 1995 (Bisack, in prep.). The average mortality between 1992 and 1995 was 6 (CV=0.31) for this fishery. 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.

The pelagic longline fishery operates in the U.S. 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 for the pelagic longline fishery (Atlantic, including the Caribbean), based on mandatory self-reported fisheries information, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). The fishery has been observed nearly year round within every statistical reporting area within the EEZ and beyond. Twenty four animals were released alive, but two were injured. One mortality was observed between 1990 and 1993. January-March by-catch was concentrated on the continental shelf edge northeast of Cape Hatteras. By-catch was recorded in this area during April-June, and takes also occurred north of Hydrographer Canyon off the continental shelf in water over 1,000 fathoms during April-June. During the July-September period, takes occurred on the continental shelf edge east of Cape Charles, Virginia, and on Block Canyon slope in over 1,000 fathoms of water. October-December by-catch occurred along the 20 to 50 fathom contour lines between Barnegatt Bay and Cape Hatteras. Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery (SEFSC unpublished data). The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery occurred in 1992 and was 22 (CV = 0.23); average annual mortality between 1992-1993 was eleven pilot whales (0.33) (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.

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. 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.

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

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	Estimated CVs	Mean Annual Mortality
Pelagic Drift Gillnet	91-95	1994=12[3] 1995=11	Obs. Data Logbook	.20, .40, .42, .87, .99	4, 14, 11[4], 17, 9	30, 33, 31, 20, 9.1[5]	.26, .16, .19, .06, 0	24.6 (.09)
Pelagic Pair Trawl	92-95	12	Obs. Data Logbook	.09, .17, .52, .54	0, 0[6], 1, 12	0, 0, 2, 22	0, 0, .49, .33	6.0 (.31)
Longline [7]	92-93		Obs. Data Logbook	.05	1	22	.23	11 (.33)
TOTAL								41.6 (.11)

[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.

[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 (Bisack, in prep).

[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] In 1993, 5 pilot whales were taken on a tow without an observer. An estimate could not be made based on unobserved tows.

[7] Assessments for 1994 and 1995 are not completed but are expected to be in the marine mammal stock assessment report next year.

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[1]	Years	Ratio	Injured	Uninjured
Pelagic Drift Gillnet	91-95	4/30, 14/33, 11/31, 17/20,9/9.1	0, 1[2], 1[3], 0, 0	0
North Atlantic Bottom Trawl	91-95	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 1, 0, 0

[1] Pilot whales have been caught and released alive in the longline fishery. However, assessments have not been completed at this time but are expected by next year.

[2] Released alive with moderate injury.

[3] Released alive with condition unknown.

Other Mortality

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

From 1992-1995, 53 long-finned pilot whale stranded between Virginia and Maine, including 22 animals that mass stranded in 1992 along the Massachusetts coast (NMFS unpublished data).

STATUS OF STOCK

The status of long-finned pilot whales relative to OSP in U.S. 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. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. The total 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 1991-95 estimated average annual fishery-related mortality to pilot whales, *Globicephala* spp., will likely exceed PBR when the 1994-95 longline data analyses are complete.

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August 1997

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

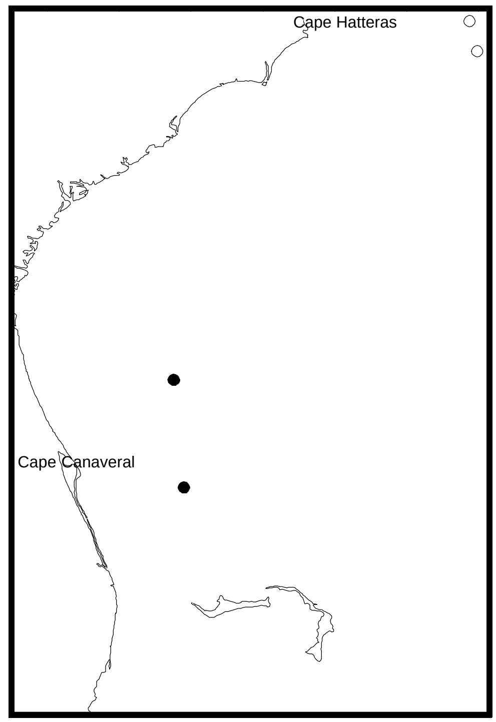

Figure 1. *Sightings of short-finned pilot whales (filled circles) and unidentified pilot whales (unfilled circles) during NOAA Ship Oregon II marine mammal survey cruise in winter 1992.*

POPULATION SIZE

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

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 (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 0.40 because of the high variance associated with the estimate of total annual fishery-related mortality and serious injury for *Globicephala* spp. PBR for the western North Atlantic short-finned pilot whales is 3.7.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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

Foreign fishery observers documented 436 pilot whale mortalities in Atlantic mackerel and squid fisheries (Waring *et al*. 1990; Waring 1995). Between 1989 and 1995, sixty -eight mortalities were observed in the large pelagic drift gillnet fishery, twenty-nine in the pelagic pair trawl fishery (1989-1995), and one each in the pelagic longline and groundfish trawl fisheries (NMFS unpublished data; see below). Although only one mortality has been observed in the U.S. large pelagic longline fishery, 24 pilot whales were released alive, two injured, after becoming entangled or hooked in this gear. Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). One mortality was observed in New England groundfish trawl fisheries in 1990 and one released alive and uninjured in 1993. Two were released alive and injured in 1992 and 1993 in the pelagic drift gillnet fishery. There were no takes in the New England multispecies sink gillnet fishery. An unknown number of pilot whales have also been taken in Newfoundland and Labrador, and Bay of Fundy, groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, and Atlantic Canada cod traps (Read 1994).

Total fishery-related mortality and serious injury cannot be estimated separately for the two species of pilot whales in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury. Total estimated annual fishery-related mortality of pilot whales from NMFS-observed fisheries was the sum of integer-rounded annual mortality estimates across the pelagic longline (1992-1993), pelagic drift gillnet (1991-1995), pelagic pair trawl (1992-1995), and North Atlantic bottom trawl fisheries (1991-1995) and was 42 pilot whales, *Globicephala* spp. (CV = 0.11) (Table 1).

Fisheries Information

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 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 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 and 1995 were 233, 243, 232, 197 and 164 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1995 there were 11 vessels in the fishery (Table 1). Observer coverage, expressed as percent of sets observed, ranged from 8% in 1989, 6% in 1990, 20% in 1991, to 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. 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 (Bisack, in prep.). 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), and 9.1 in 1995 (0); average annual mortality between 1991-1995 was 24.6 pilot whales (0.09) (Table 1). The 1991-1995 period provides a better characterization of this fishery (i.e., fewer vessels and increased observer coverage). 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. Because animals released alive may have subsequently died due to injuries received during entanglement, pilot whales that were released were included in the mortality estimates. Pilot whales were taken along the continental shelf edge, northeast of Cape Hatteras in January and February. Takes were recorded at the continental shelf edge east of Cape Charles, Virginia, in June. Pilot whales were taken from Hydrographer Canyon along the Great South Channel to Georges Bank from July-November. Takes occurred at the Oceanographer Canyon continental shelf break and along the continental shelf northeast of Cape Hatteras in October-November.

Effort in the 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. 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, 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* spp.) mortalities were reported in the self-reported fisheries information in 1993. In 1994 and 1995 observers reported one and twelve mortalities, respectively (Table 1). The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery in 1994 was 2.0 (CV=0.49) and 22 (CV=0.33) in 1995 (Bisack, in prep.). The average mortality between 1992 and 1995 was 6 (CV=0.31) for this fishery. 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.

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 for the pelagic longline fishery (Atlantic, including the Caribbean), based on mandatory self-reported fisheries information, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). The fishery has been observed nearly year round within every statistical reporting area within the EEZ and beyond. Twenty-four animals were released alive, but two were injured. One mortality was observed between 1990 and 1993. January-March by-catch was concentrated on the continental shelf edge northeast of Cape Hatteras. By-catch was recorded in this area during April-June, and takes also occurred north of Hydrographer Canyon off the continental shelf in water over 1,000 fathoms during April-June. During the July-September period, takes occurred on the continental shelf edge east of Cape Charles, Virginia, and on Block Canyon slope in over 1,000 fathoms of water. October-December by-catch occurred along the 20 to 50 fathom contour lines between Barnegatt Bay and Cape Hatteras. Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery (SEFSC unpublished data). The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery occurred in 1992 and was 22 (CV = 0.23); average annual mortality between 1992-1993 was eleven pilot whales (0.33) (Table 1). 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.

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. 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.

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

Table 1. 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	Estimated CVs	Mean Annual Mortality
Pelagic Drift Gillnet	91-95	1994=12[3] 1995=11	Obs. Data Logbook	.20, .40, .42, .87, .99	4, 14, 11[4], 17, 9	30, 33, 31, 20, 9.1[5]	.26, .16, .19, .06, 0	24.6 (.09)
Pelagic Pair Trawl	92-95	12	Obs. Data Logbook	.09, .17, .52, .54	0, 0[6], 1, 12	0, 0, 2, 22	0, 0, .49, .33	6.0 (.31)
Longline [7]	92-93		Obs. Data Logbook	.05	1	22	.23	11 (.33)
TOTAL								41.6 (.11)

[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.

[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 (Bisack, in prep).

[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] In 1993, 5 pilot whales were taken on a tow without an observer. An estimate could not be made based on unobserved tows.

[7] Assessments for 1994 and 1995 are not completed but are expected to be in the marine mammal stock assessment report next year.

Table 2. 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[1]	Years	Ratio	Injured	Uninjured
Pelagic Drift Gillnet	91-95	4/30, 14/33, 11/31, 17/20,9/9.1	0, 1[2], 1[3], 0, 0	0
North Atlantic Bottom Trawl	91-95	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 1, 0, 0

[1] Pilot whales have been caught and released alive in the longline fishery. However, assessments have not been completed at this time but are expected by next year.

[2] Released alive with moderate injury.

[3] Released alive with condition unknown.

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Other Mortality

There were 190 short-finned pilot whale strandings documented during 1987- August 1996 along the U.S. Atlantic coast between Cape Hatteras, North Carolina, and Miami, Florida; four 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 U.S. 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 1991-95 estimated average annual fishery-related mortality to pilot whales, *Globicephala* spp., will likely exceed PBR when the 1994-95 longline data analyses are complete.

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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.*, in press). 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 (Palka and Waring, in prep.). 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. 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). From January to May, fewer dolphins are found in the southern Gulf of Maine and Georges Bank areas and a few strandings have been collected on beaches of Virginia and North Carolina. Sightings south of Georges Bank, and around Hudson Canyon, have been seen at all times of the year but at very low densities. These southern observations appear to represent the southern extent of the species range.

Prior to the 1970's, white-sided dolphins in U.S. 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 these continental shelf waters (Katona *et al.* 1993; Kenny *et al.* 1996).

POPULATION SIZE

The total number of white-sided dolphins along the eastern U.S. 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

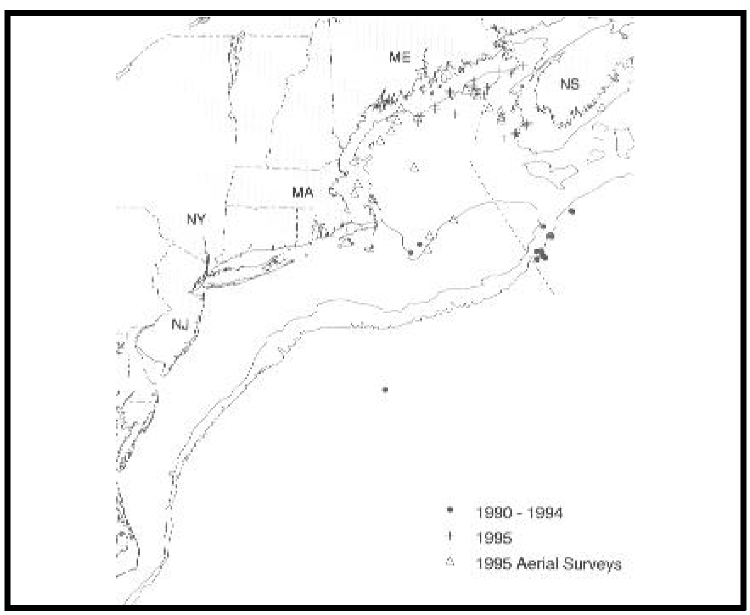

Figure 1. *Distribution of white-sided dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

were chosen because the greatest proportion of the population off the northeast U.S. 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. 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, an estimate of g(0), probability of detecting a group on the track line, but no correction for dive-time. Variability was estimated using bootstrap resampling.

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) or dive-time. Variability was estimated using bootstrap resampling 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; Palka and Waring, in prep.). 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.

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 is 27,200 (CV=0.43) for U.S. waters as estimated from the July to September 1995 line transect survey (Palka and Waring, in prep.) 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 (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 0.5 because this stock is of unknown status. PBR for the western North Atlantic white-sided dolphin is 192.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

In the past, incidental takes of white-sided dolphins have been recorded in the New England and Bay of Fundy groundfish gillnet fisheries and the Atlantic foreign mackerel fishery. In the mid 1980's, during a University of Maine study, gillnet fishermen retained six carcasses 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 U.S. vessels involved in joint-venture fishing operations in which U.S. captains transfer their catches to foreign processing vessels.

Recently, within U.S. waters, white-sided dolphins have been caught in the pelagic drift gillnet fishery, and the North Atlantic bottom trawl and New England multispecies sink gillnet fisheries (Table 2). During 1991 to 1995, two white-sided dolphins were observed taken in the Atlantic pelagic drift gillnet fishery, resulting in an estimated average annual mortality and serious injury of 0.9 white-sided dolphins (0.51). Three mortalities were documented between 1991 and 1995 in the North Atlantic bottom trawl fishery, resulting in an average annual estimate fishery-related mortality of 58.4 white-sided dolphins (CV = 0.57). Between 1990 and 1995 there were 33 mortalities observed in the New England multispecies sink gill fishery, resulting in an average annual estimated fishery-related mortality of 121 white-sided dolphins (CV = 0.24)

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

Estimated average annual fishery-related mortality and serious injury to the western North Atlantic white-sided dolphin stock during 1990-1995 was 181 dolphins (CV = 0.25).

Fisheries Information

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 provides observer coverage of vessels fishing south of Cape Hatteras.

White-sided dolphin bycatch has been observed by NMFS Sea Samplers in the 1970-80's Atlantic foreign mackerel and joint-venture fisheries, and the more recent Atlantic pelagic drift gillnet, North Atlantic bottom trawl fisheries, and New England multispecies sink gillnet.

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

The estimated total number of hauls in the Atlantic 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 and 1995 were 233, 243, 232, 197 and 164 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994 and 1995 there were 11 and 12 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 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 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 logbooks. Variances were estimated using bootstrap re-sampling techniques (Bisack, in prep.). 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 and 0 in 1995. Estimated average annual mortality and serious injury during related to this fishery during 1991-1995 was 0.9 white-sided dolphins (0.22) (Table 2).

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. Three mortalities were documented between 1991 and 1995 (Table 2). 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, in prep.). The average annual estimate fishery-related mortality during 1991-1995 was 58.4 white-sided dolphins (CV = 0.57) (Table 2).

There are approximately 349 vessels (full and part time) in the New England multispecies sink gillnet fishery (Walden 1996). Observer coverage in trips has been 1%, 6%, 7%, 5%, 7%, and 5% for years 1990 to 1995. The fishery has been observed in the Gulf of Maine and in Southern New England. There have been 33 mortalities observed in this fishery between 1990 and 1995. 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), and 80 in 1995 (1.16) (Bisack, in prep.). Average annual estimated fishery-related mortality during 1990-1995 was 121 white-sided dolphins (0.24) (Table 2). In January to March, the by-catch occurred in Massachusetts Bay, south of Cape Ann and west of Stellwagen Bank. From April to June, by-catch locations became more dispersed, from Casco Bay to Cape Ann, along the 30 fathom contour out to Jeffreys Ledge, with one take location near Cultivator Shoal and one in southern New England near Block Island. In July through September, incidental takes occurred from Frenchman's Bay to Massachusetts Bay. In inshore waters, the takes were aggregated while offshore takes were more dispersed. In October through December, takes were confined from Cape Elizabeth out to Jeffreys Ledge and south to Nantucket Sound.

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	90-95	349	Obs. Data Weighout	.01, .06, .07, .05, .07, .05	0, 4, 9, 7,10[3], 2	0, 49, 154, 205, 240[3], 80	0, .46, .35, .31, .51, 1.16	121.3 (.24)
Pelagic Drift Gillnet	91-95	1994=11[4] 1995=12	Obs. Data Logbook	.20, .40, .42, .87, .99	0, 0, 2, 0, 0	0.9[5], 0.8, 2.7, 0, 0	.71, .71, 0.17, 0, 0	0.9 (.22)
North Atlantic Bottom Trawl	91-95	970	Obs. Data Weighout	.007, .006, .004, .004, .011[6]	0, 1, 0, 2, 0	0, 110, 0, 182, 0	0, .97, 0, .71, 0	58.4 (.57)
Total								180.6 (.25)

[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 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] The observer coverage for the sink gillnet fishery is measured in trips, the pelagic drift gillnet fishery is measured in sets, and the Atlantic bottom trawl fishery is in days fished.

[3] White-sided dolphins taken on observed pinger trips were added directly to the estimated total bycatch for that year. There was one observed white-sided dolphin take on a pinger trip in 1994, which was not included in the observed mortality.

[4] 1994 and 1995 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. This method is described in Northridge (1996).

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

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 are 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.

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

Among mature females in a mass stranding in Maine, 47% were infected with the nematode *Crassicauda grampicola* in the mammary glands. Geraci *et al.* (1978) suggested that the relatively high incidence and severity of lesions resulting from this parasitism could negatively affect reproductive performance of these animals.

STATUS OF STOCK

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

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

White-beaked dolphins are the more northerly of the two species of *Lagenorhynchus* in the Northwest Atlantic (Leatherwood *et al.* 1976). The species is found in waters from southern New England, north to western and southern Greenland and Davis Straits (Leatherwood *et al.* 1976; CeTAP 1982), in the Barents Sea and south to at least Portugal (Reeves *et al.*, in press). Differences in skull features indicate that there are at least two separate stocks, one in the eastern and one in the western North Atlantic (Mikkelsen and Lund 1994). No genetic analyzes have been conducted to distinguish the stock structure.

In waters off the northeastern U.S. coast, white-beaked dolphin sightings have been concentrated in the western Gulf of Maine and around Cape Cod (CeTAP 1982). The limited distribution of this species in U.S. waters has been attributed to opportunistic feeding (CeTAP 1982). Prior to the 1970's, white-sided dolphins (*L. acutus*) in U.S. waters were found primarily offshore on the continental slope, while white-beaked dolphins 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 have been a result of the increase in sand lance in the continental shelf waters (Katona *et al.* 1993; Kenny *et al.* 1996).

POPULATION SIZE

The total number of white-beaked dolphins in U.S.and Canadian waters is unknown, although one abundance estimate is available for part of the known habitat in U.S. waters, and two estimates are from Canadian waters (Table 1).

A population size of 573 white-beaked dolphins (CV=0.69) 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 U.S. 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 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 5,500 white-beaked dolphins was based on an aerial survey off eastern Newfoundland and southeastern Labrador (Table 1; Alling and Whitehead 1987).

A population size of 3,486 white-beaked dolphins [95% confidence interval (CI) = 2,001-4,971]was estimated from a ship-based survey of a small segment of the Labrador Shelf in August 1982 (Table 1; Alling and Whitehead 1987). A CV was not given, but, assuming a symmetric CI, it would be 0.22.

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

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

Month/Year	Area	N_{best}	CV
spring 1978-82	Cape Hatteras, NC to Nova Scotia	573	0.69
1980's	E. Newfoundland and SE Labrador	5,500	unk
August 1982	Labrador shelf	3,486	0.22

Minimum Population Estimate

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

Current Population Trend

There are insufficient data to determine 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 (Wade and Angliss 1997). The minimum population size of white-beaked dolphins 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 white-beaked dolphin is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

White-beaked dolphins have been taken in cod traps and the Canadian groundfish gillnet fisheries off Newfoundland and Labrador and in the Gulf of St. Lawrence (Alling and Whitehead 1987; Read 1994; Hai *et al.* 1996); however, the total number of animals taken is not known.

There are no documented reports of fishery-related mortality or serious injury to this stock in the U.S. EEZ.

Fisheries Information

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

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

Other Mortality

White-beaked dolphins were hunted for food by residents in Newfoundland and Labrador (Alling and Whitehead 1987). These authors, based on interview data, estimated that 366 white-beaked dolphins were taken each year. The same authors reported that 25-50% of the killed dolphins were lost.

STATUS OF STOCK

The status of white-beaked dolphins, relative to OSP, in U.S. Atlantic coast waters is unknown. They are not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this species. Because there are insufficient data to calculate PBR it is not possible to determine if stock is strategic and if the total fishery-related mortality and serious injury for this stock is significant and approaching zero mortality and serious injury rate. However, because this stock has a marginal occurrence in U.S. waters and there are no documented takes in U.S. waters, this stock has been designated as not strategic.

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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 U.S. coast (CeTAP 1982; Selzer and Payne 1988; Waring *et al* 1992). They are widespread from Cape Hatteras northeast to Georges Bank (35º to 42º North latitude) in outer continental shelf waters from mid-January to May (Hain *et al*. 1981; CeTAP 1982; Payne *et al*. 1984). Common dolphins move northward onto Georges Bank and the Scotian Shelf from mid-summer to autumn. Selzer and Payne (1988) reported very large aggregations (greater than 3,000 animals) on Georges Bank in autumn. Common dolphins are rarely found in the Gulf of Maine, where temperature and salinity regimes are lower than on the continental slope of the Georges Bank/mid-Atlantic region (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11°C (Sergeant *et al*. 1970; Gowans and Whitehead 1995).

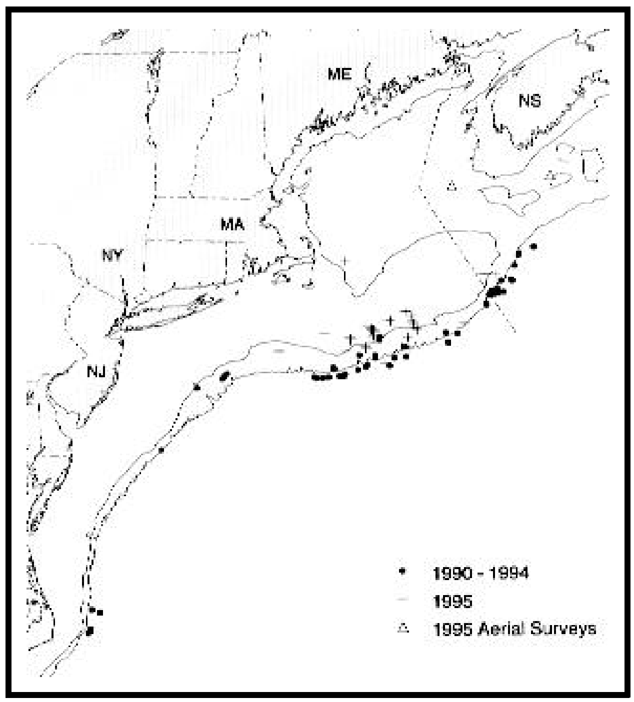

Figure 1. *Distribution of common dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

POPULATION SIZE

The total number of common dolphins off the eastern U.S. 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 U.S. 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 22,215[1] (CV=0.45) 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). 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; Palka and Waring, in prep.). 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 U.S. 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=0.45) 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).

[1]In June 1997, a coding error was found in the 1991 shipboard data file which impacted the stratification component of the DISTANCE analysis. The revised value reflects this correction, it does not represent a new analysis of the 1991 survey data. This error occurred in the analysis of pilot whales, common dolphins, Risso's dolphins and offshore bottlenose dolphins. The revised numbers **have not** been reviewed by the Atlantic Scientific Review Group or the Atlantic Offshore Take Reduction Team. Details are contained in G. Waring, Memo to The Record, August 1997.

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	0.45
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=0.45). The minimum population estimate for the western North Atlantic common dolphin is 15,470(CV=0.45) (see footnote 1, Population Size).

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 (Wade and Angliss 1997). The minimum population size is 15,470 (CV=0.45). 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 common dolphin is 155 (see footnote 1, Population Size).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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

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

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

Estimated average annual mortality and serious injury for all of the NMFS-observed fisheries is 233.6 common dolphins per year (CV = 0.10) (Table 2).

Fisheries Information

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

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

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory 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, mid-Atlantic coastal sink gillnet, and North Atlantic bottom trawl fisheries, but no mortalities or serious injuries have documented in pelagic longline fishery.

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 and 1995 were 233, 243, 232, 197 and 164 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, 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 pelagicdrift 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 (Bisack, in prep.). Five hundred and thirty-two common dolphin mortalities were observed between 1989 and 1995 in this fishery. Mortalities were observed in all seasons and areas. Five animals were released alive, but four were injured. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 540 in 1989 (0.19), 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), and 83 in 1995 (0); average annual estimated fishery-related mortality during 1991-1995 attributable to this fishery was 187 common dolphins (CV=0.04) (Table 2). The 1991-1995 period provides a better characterization of this fishery (i.e., fewer vessels and increased 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.

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. 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 (Bisack, in prep.). Sea sampling began in October of 1992 where 48 sets (9% of the total) were sampled. In 1993, 102 hauls (17% of the total) were sampled. In 1994 and 1995, 52% and 55%, 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). Average annual estimate fishery-related mortality attributable to this fishery during 1992-1993 was 18.2 common dolphins (CV = 0.30) (Table 2).

During the 1994 and 1995 experimental fishing seasons, fishing gear experiments were conducted to collect data on enviornmental 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.

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. Three mortalities were observed between 1991-1995. 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), and 142 in 1995 (0.77) (Bisack, in prep.). Average annual estimate fishery-related mortality attributable to this fishery during 1991-1995 was 28.4 common dolphins (CV = 0.77) (Table 2).

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 Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Drift Gillnet	91-95	1994=11 1995=12 [3]	Obs. Data Logbook	.20, .40, .42, .87, .99	55, 97, 113, 142,82	223, 227, 238, 163, 83[4]	.12, .09, .08, .02, 0	187.0 (.04)
Pelagic Pair Trawl	92-95	12	Obs. Data Logbook	.10, .18, .52, .54	3, 6, 0, 3	32, 35, 0, 5.6	.48, .43, 0, .35	18.2 (.30)
Mid-Atlantic Coastal Sink Gillnet	93-95		Obs. Data Weighout	20, 221, 369	0, 0, 1[5]			
North Atlantic Bottom Trawl	91-95	970	Obs. Data Weighout	.007, .006, .004, .004, .011[6]	0, 0, 0, 0, 3	0, 0, 0, 0, 142	0, 0, 0, 0, .77	28.4 (.77)
TOTAL								233.6 (.10)

[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 and 1995 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] Common dolphin bycatch estimates for the coastal sink gillnet fishery have not been made. They are expected in the marine mammals stock assessment report next year.

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

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	Uninjured
Pelagic Drift Gillnet	91-95	55/223, 97/227, 113/238, 142/163, 82/83	0, 1[1], 3[2], 1[3], 0	0, 1, 0, 0, 0

[1] Released alive and severely injured.
[2] Released alive, 2 were moderately injured and 1 common dolphin was severely injured.
[3] Released alive and gear was "in/around several body parts".

Other Mortality

From 1992-1995, 39 common dolphins were stranded between Delaware and Massachusetts, predominantly along beaches in the latter state (NMFS unpublished data).

STATUS OF STOCK

The status of common dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. 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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ATLANTIC SPOTTED DOLPHIN (*Stenella frontalis*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

POPULATION SIZE

The total number of Atlantic spotted dolphins off the eastern U.S. 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 U.S. 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.

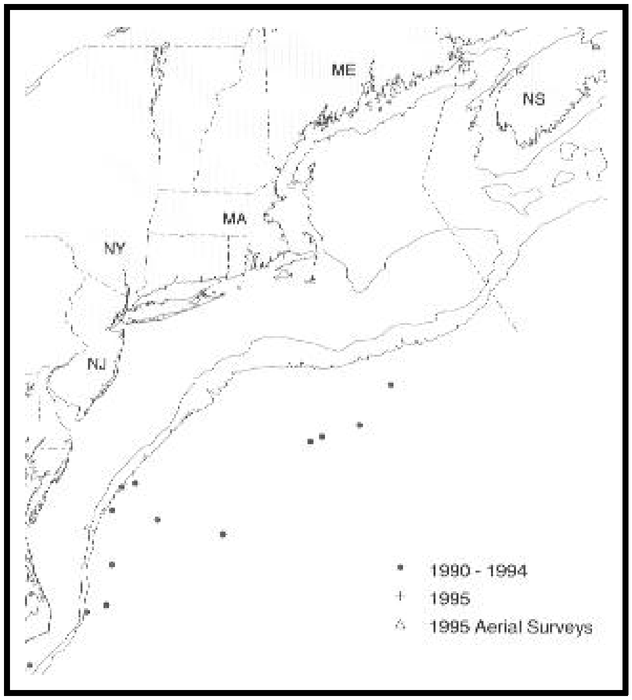

Figure 1. *Distribution of spotted dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

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; Palka and Waring, in prep.). 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 (Palka and Waring, in prep.) 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 (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. It is not possoble to calculate a PBR for the Atlantic spotted dolphin (*S. frontalis*) stock alone because it was impossible to separately identify the two species.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No spotted dolphin mortalities were observed in 1977-1991 foreign fishing activities. Forty-eight mortalities have been documented between 1989 and 1995 in the pelagic drift gillnet fishery. Six whole animal carcasses that were sent to the Smithsonian were identified as Pantropical spotted dolphins (*Stenella attenuata*). The remaining animals were not identified to species. No mortalities were 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).

The 1991-1995 total average estimated annual fishery-related mortality of spotted dolphins in the U.S. EEZ was 21.7 (CV=0.12) (Table 2). The 1991-1995 period provides a better characterization of the pelagic drift gillnet fishery (i.e., fewer vessels and increased observer coverage).

Fisheries Information

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 provides observer coverage of vessels fishing south of Cape Hatteras. Total fishery-related mortality and serious injury cannot be estimated separately for the two species of spotted dolphins in the U.S. Atlantic Exclusive Economic Zone (EEZ) because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury.

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, mid-Atlantic coastal sink gillnet, and North Atlantic bottom trawl 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 and 1995 were 233, 243, 232, 197 and 164, respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, 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. 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 (Bisack, in prep.). Forty-seven spotted dolphin mortalities were observed in the drift gillnet fishery between 1989 and 1995 and occurred northeast of Cape Hatteras within the 183 m isobath in February-April, and near Lydonia Canyon in October. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 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), and 0 in 1995; average annual mortality and serious injury during 1991-1995 was 13.7 (0.10) (Table 2).

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 for the pelagic longline fishery (Atlantic, including the Caribbean), based on mandatory self-reported fisheries information, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery (SEFSC unpublished data). Annual estimates of mortality and serious injury were based on observed takes across the entire pelagic longline fishery (including the Gulf of Mexico). All observed takes were used because the species occurs throughout the area of the fishery, but observed takes were infrequent in any given region of the fishery. There was no mortality or serious injury reported in 1992 and estimated fishery-related mortality and serious injury to spotted dolphins (both species) in the pelagic longline fishery in 1993 was 16 (CV = 0.19); average annual mortality and serious injury attributable to this fishery in 1992-1993 was 8.0 spotted dolphins (CV = 0.27) (Table 2).

Table 2. Summary of the incidental mortality of spotted dolphins (*Stenella frontalis*) 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	91-95	1994=11[3] 1995=12	Obs. Data Logbook	.20, .40, .42, .87, .99	0, 12, 0, 29, 0	11[4], 20, 8.4, 29, 0	.41, .18, .40, .01, 0	13.7 (.10)
Longline[5]	92-93		Obs. Data Logbook	.05		0, 16	0, .19	8 (.27)
TOTAL								21.7 (.12)

[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 (Bisack, in prep).

[5] Assessments for 1994 and 1995 are not completed but are expected to be in the marine mammal stock assessment report next year.

STATUS OF STOCK

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

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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 U.S. Atlantic coast (SEFSC unpublished data). Some of the Pacific populations have been divided into different geographic stocks based on morphological characteristics (Perrin *et al*. 1987; Perrin and Hohn 1994); however, there is no information on stock differentiation in the Atlantic population.

POPULATION SIZE

The total number of pantropical spotted dolphins off the eastern U.S. coast is unknown; however, two abundance estimates are available for the combination of both spotted dolphin species within portions of the northeastern U.S. 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.

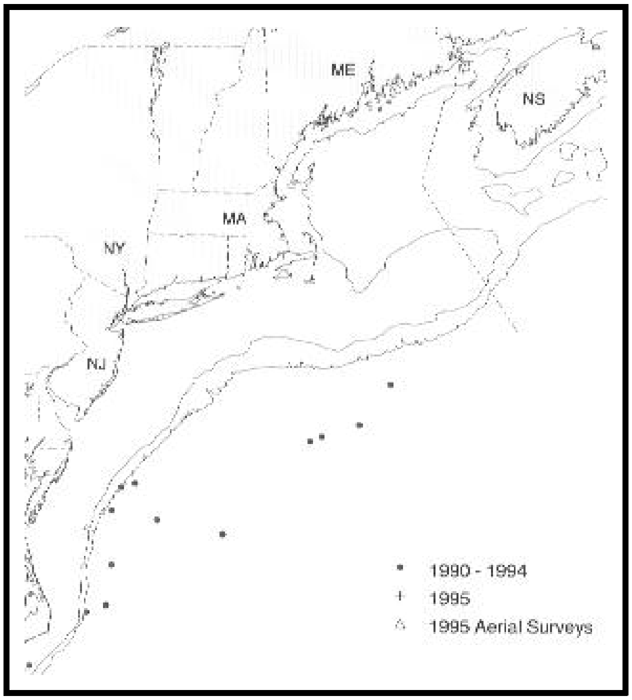

Figure 1. *Distribution of spotted dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

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 U.S. 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; Palka and Waring, in prep.). 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 (Palka and Waring, in prep.) 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 (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 inappropriate to calculate a PBR for only the pantropical spotted dolphin because it was impossible to separately identify the two species.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No spotted dolphin mortalities were observed in 1977-1991 foreign fishing activities. Forty-eight mortalities have been documented between 1989 and 1995 in the pelagic drift gillnet fishery. Six whole animal carcasses that were sent to the Smithsonian were identified as pantropical spotted dolphins (*S. attenuata*). The remaining animals were not identified to species. No mortalities were documented in a review of Canadian gillnet and trap fisheries (Read 1994).

The 1991-1995 total average estimated annual fishery-related mortality of spotted dolphins in the U.S. EEZ was 21.7 (CV = 0.12) (Table 2). The 1991-1995 period provides a better characterization of the pelagic drift gillnet fishery (i.e., fewer vessels and increased observer coverage).

Fisheries Information

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 provides observer coverage of vessels fishing south of Cape Hatteras. Total fishery-related mortality and serious injury cannot be estimated separately for the two species of spotted dolphins in the U.S. Atlantic Exclusive Economic Zone (EEZ) because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury.

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, mid-Atlantic coastal sink gillnet, and North Atlantic bottom trawl 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 and 1995 were 233, 243, 232, 197 and 164, respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, 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. 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 (Bisack, in prep.). Forty-seven spotted dolphin mortalities were observed in the drift gillnet fishery between 1989 and 1995 and occurred northeast of Cape Hatteras within the 183 m isobath in February-April, and near Lydonia Canyon in October. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 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), and 0 in 1995; average annual mortality and serious injury during 1991-1995 was 13.7 (0.10) (Table 2).

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 for the pelagic longline fishery (Atlantic, including the Caribbean), based on mandatory self-reported fisheries information, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery (SEFSC unpublished data). Annual estimates of mortality and serious injury were based on observed takes across the entire pelagic longline fishery (including the Gulf of Mexico). All observed takes were used because the species occurs throughout the area of the fishery, but observed takes were infrequent in any given region of the fishery. There was no mortality or serious injury reported in 1992 and estimated fishery-related mortality and serious injury to spotted dolphins (both species) in the pelagic longline fishery in 1993 was 16 (CV = 0.19); average annual mortality and serious injury attributable to this fishery in 1992-1993 was 8.0 spotted dolphins (CV = 0.27) (Table 2).

Table 2. Summary of incidental mortality of spotted dolphins due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate (CV in parentheses).

Fishery	Years	Number Vessel	Data Type[1]	Range of Observer Coverage[2]	Observed Mortality	Estimated Mortality	CVs	Mean Annual Mortality
Pelagic Drift Gillnet	91-95	1994=11[3] 1995=12	Obs Data Logbook	.20, .40, .42, .87, .99	0, 12, 0, 28, 0	11[4], 20, 8.4, 29, 0	.41, .18, .40, .76, 0	13.7 (.10)
Longline[5]	92-93		Obs Data Logbook	.05 (1992)		0, 16	0, .19	8 (.27)
TOTAL								21.7 (.12)

[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 (Bisack, in prep).

[5] Assessments for 1994 and 1995 are not completed but are expected to be in the marine mammal stock assessment report next year.

STATUS OF STOCK

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

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

POPULATION SIZE

The total number of striped dolphins in the U.S. Exclusive Economic Zone (EEZ) is unknown; however, three abundance estimates are available for for portions of the northeastern U.S. Atlantic during spring and summer 1978-82, August to September 1991, and July to September 1995 (Table 1; Figure 1).

A population size of 36,780 striped 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 that accounted for survey effort in two continental slope survey blocks and uncertainties resulting from sighting 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 U.S. 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 (e.g., large CV), its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region.

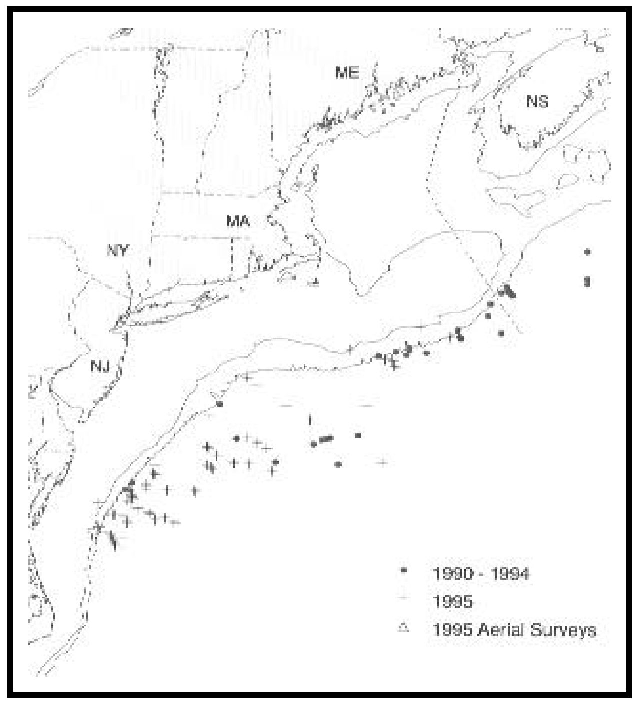

Figure 1. *Distribution of striped dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

A population size of 25,939 (CV=0.36) and 13,157 (CV=0.45) spotted 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.

Due to insufficient numbers of striped dolphin sightings collected during the August 1990, June-July 1991, and June-July 1993 sighting surveys, spotted dolphin abundances for these surveys were not estimated.

A population size of 31,669 (CV=0.73) striped 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; Palka and Waring, in prep.). 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 striped dolphins is 31,669 (CV=0.73) as estimated from the July to September 1995 line transect survey (Palka and Waring, in prep.) 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 striped 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	37,780	0.27
Aug-Sep 1991	Cape Hatteras, NC to Nova Scotia	25,939 and 13,157*	0.36 and 0.45*
Jul-Sep 1995	Virginia to Gulf of St. Lawrence	31,669	0.73

* 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 striped dolphins is 31,669 (CV=0.73). The minimum population estimate for the western North Atlantic striped dolphin is 18,220 (CV=0.73).

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 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 18,220 (CV=0.73).

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 0.45 because this stock is of unknown status and the variance associated with the estimated total annual fishery-related mortality and serious injury for striped dolphins is high (CV = 0.75). PBR for the western North Atlantic striped dolphin is 164.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

No mortalities were observed in 1977-1991 foreign fishing activities off the northeast U.S. coast. Nineteen mortalities were documented between 1989 and 1993 (see below) in the pelagic drift gillnet fishery, and two mortalities were documented in 1991 in the North Atlantic bottom trawl fishery. No mortalities were documented in review of Canadian gillnet and trap fisheries (Read 1994).

Total estimated average annual fishery-related mortality and serious injury to this stock in the Atlantic during 1991-1995 was 47.1 striped dolphins annually (CV = 0.75) (Table 2).

Fisheries Information

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 provides observer coverage of vessels fishing south of Cape Hatteras.

By-catch has been observed by NMFS Sea Samplers in the pelagic drift gillnet and North Atlantic bottom trawl fisheries but no mortalities or serious injuries have been documented in the pelagic longline fisheries, pelagic pair trawl, New England multispecies sink gillnet, and mid-Atlantic coastal sink gillnet 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 and 1995 were 233, 243, 232, 197 and 164 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1995 there were 11 vessels 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 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. 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 (Bisack, in prep.). Thirty-three striped dolphin mortalities were observed in this fishery between 1989 and 1995 and occurred east of Cape Hatteras in January and February, and along the southern margin of Georges Bank in summer and autumn. Estimated annual mortality and serious injury (CV in parentheses) attributable to this fishery was 39 striped dolphins in 1989 (0.31), 57 in 1990 (0.33), 11 in 1991 (0.28), 7.7 in 1992 (0.31), 21 in 1993 (0.11), 13 in 1994 (0.06) and 2 in 1995 (0). The 1991-1995 average annual mortality and serious injury to striped dolphins in the pelagic drift gillnet fishery was 10.9 dolphins (0.08) (Table 2). The 1991-1995 period provides a better characterization of this fishery (i.e., fewer vessels and increased observer coverage).

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 vessels (full and part time) participated annually in the fishery during 1989-1995. The fishery is active in New England waters in all seasons. The only reported fishery-related mortalities (two) occurred in 1991. Total estimated mortality and serious injury attributable to this fishery in 1991 was 181 (CV = 0.97); average annual mortality and serious injury during 1991-1995 was 36 striped dolphins (CV = 0.97) (Table 2).

Table 2. Summary of incidental mortality of striped dolphins due to commercial fisheries from 1990 through 1995 and calculation of the mean annual mortality rate (CV in parentheses).

Fishery	Years	Number Vessel	Data Type[1]	Range of Observer Coverage[2]	Observed Mortality	Estimated Mortality	CVs	Mean Annual Mortality
Pelagic Drift Gillnet	91-95	1994=12[3] 1995=11	Obs Data Logbook	Sets .20, .40, .42, .87, .99	1, 0, 13, 12, 2	11, 7.7[4], 21, 13, 2.0[5]	.28, .31, .11, .06, 0	10.9 (.08)
North Atlantic Bottom Trawl	91-95	970	Obs Data Weighout	Days Fished .007,.006.004,.004 .011[6]	2, 0, 0, 0, 0	181, 0, 0, 0, 0	.97, 0, 0, 0, 0	36.2 (.97)
TOTAL								47.1 (.75)

[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 and bottom trawl fishery are in terms of sets.

[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 (Bisack, in prep).

[5] One vessel was not observed and recorded 1 set in a 10 day trip (in the logbook). If you assume 1 set, the point estimate would increase by 0.01 animals.

[6] Only January - May data available for 1995 effort (Weighout). All 1995 marine mammal bycatch occurred during January to May.

STATUS OF STOCK

The status of striped dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. 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 cannot be considered to be insignificant and approaching zero mortality and serious injury rate. Average annual fishery-related mortality and serious injury does not exceed the PBR; therefore, this is not a strategic stock.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

POPULATION SIZE

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

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are 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 spinner dolphin is unknown because the minimum population size is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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

Total average annual estimated average fishery-related mortality and serious injury to this stock in the Atlantic during 1989-1993 was 1.0 spinner dolphin (CV = .42).

Fisheries Information

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 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, mid-Atlantic coastal sink gillnet, and North Atlantic bottom trawl 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, and 1993 were 233, 243, and 232 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, to 40% in 1992, and 42% in 1993. Effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras. Examination of the species composition of the catch and locations of the fishery throughout the year, suggested that the 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, were obtained using the aggregated (pooled 1989-1993) catch rates, by strata (Northridge 1996). One spinner dolphin mortality was observed between 1989 and 1993 and occurred east of Cape Hatteras in March 1993. Estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 0.7 in 1989 (1. 00), 1.7 in 1990 (1.00), 0.7 in 1991 (1.00), 1.4 in 1992 (0.31), and 0.5 in 1993 (1.00).

STATUS OF STOCK

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

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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).

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.

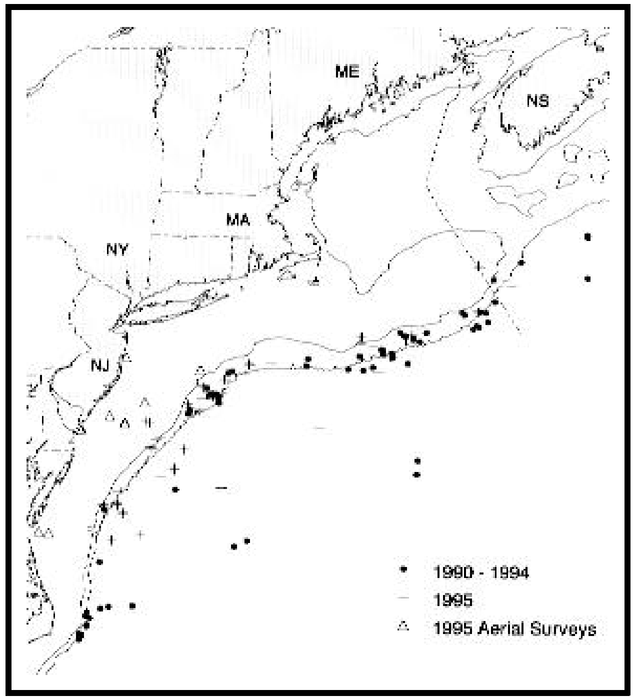

Figure 1. *Distribution of bottlenose dolphin sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

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. No distribution or abundance data are available from Canadian waters. Dolphins with characteristics of the offshore type have been stranded as far south as the Florida Keys, but there are no abundance or distribution estimates available for this stock in U.S. Exclusive Economic Zone (EEZ) waters south of Cape Hatteras.

POPULATION SIZE

The total number of bottlenose dolphins off the Atlantic U.S. coast is unknown; however, six abundance estimates are available for portions of the northeastern U.S. 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 U.S. 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[1] offshore bottlenose dolphins (CV=0.34) 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 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; Palka and Waring, in prep.). 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 U.S. 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

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[1] In June 1997, a coding error was found in the 1991 shipboard data file which impacted the stratification component of the DISTANCE analysis. The revised value reflects this correction, it does not represent a new analysis of the 1991 survey data. This error occurred in the analysis of pilot whales, common dolphins, Risso's dolphins and offshore bottlenose dolphins. The revised numbers **have not** been reviewed by the Atlantic Scientific Review Group or the Atlantic Offshore Take Reduction Team. Details are contained in G. Waring, Memo to The Record, August 1997.

survey (Palka and Waring, in prep.) 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	0.34
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 (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

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

Estimated average annual fishery-related mortality or serious injury to this stock is 82 offshore bottlenose dolphins (CV = 0.27).

Fishery Information

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

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory 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, mid-Atlantic coastal sink gillnet, and North Atlantic bottom trawl fisheries, but no mortalities have documented in pelagic longline fishery.

Although there have been no reported mortalities of this stock by the pelagic longline fishery, one bottlenose dolphin was taken and released alive during 1993 in offshore waters outside of the U.S. EEZ (NMFS unpublished data). Vessels in this fishery 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 for the pelagic longline fishery (Atlantic, including the Caribbean), based on mandatory self-reported fisheries information, was 11,279 sets in 1991, 10,605 sets in 1992, and 11,538 in 1993 (Cramer 1994). The fishery has been observed nearly year round within every statistical reporting area within the EEZ and beyond.

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 and 1995 were 233, 243, 232, 197 and 164 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1995 there were 11 vessels in the fishery (Table 2). Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, to 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. 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 (Bisack, in prep.). Fifty-seven bottlenose dolphin mortalities have been observed between 1989 and 1995. 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), and 5 in 1995 (0). Mean annual estimated fishery-related mortality for this fishery in 1991-1995 was 18.8 bottlenose dolphins (CV=0.06) (Table 2).

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. 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 (Bisack, in prep.). Sea sampling began in October 1992, 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-three 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). The 1992-1995 estimated mean annual bottlenose dolphin mortality attributable to this fishery is 45 (CV=0.28) (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.

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) (Bisack, in prep.). The average fishery-related mortality attributable to this fishery between 1991-1995 was 18 bottlenose dolphins (CV = 0.97).

The mid-Atlantic mackerel and squid trawl fisheries were combined into the Atlantic squid, mackerel and butterfish trawl fishery in 1996. The fishery occurs along the U.S. mid-Atlantic continental shelf region between New Brunswick, Canada, and Cape Hatteras year around. The mackerel trawl fishery was classified as a Category II fishery since 1990 and the squid fishery was originally classified as a Category II fishery in 1990, but was reclassified as a Category III fishery in 1992. The combined fishery has been proposed for classification as a Category II fishery. Although there were reports of bottlenose dolphin mortalities in the foreign fishery during 1977-1988, there were no fishery-related mortalities of bottlenose dolphins reported in 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	91-95	1994=11[3] 1995=12	Obs. Data Logbook	.20, .40, .42, .87, .99	5, 12, 6, 12, 5	26, 28, 22, 13, 5.0[4]	.14, .10, .13, .05, 0	18.8 (.06)
Pelagic Pair Trawl	92-95	12	Obs. Data Logbook	.10, .18, .52, .54	4, 17, 3, 9	73, 85, 4.0, 17	.49, .41, .40, .26	44.8 (.28)
North Atlantic Bottom Trawl	91-95	970	Obs. Data Weighout	.007, .006, .004, .004, .011[5]	1, 0, 0, 0, 0	91, 0, 0, 0, 0	.97, 0, 0, 0, 0	18.2 (.97)
Mid-Atlantic Coastal Sink Gillnet Gillnet	93-95		Obs. Data	20, 221, 369	0, 1, 0			
TOTAL								81.8 (.27)

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

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	Uninjured
Pelagic Pair Trawl	92-95	4/73, 17/85, 3/4, 9/17	0, 0, 1 [1] , 0	0, 0, 0, 0

[1] Released alive, condition unknown.

Other Mortality

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

STATUS OF STOCK

The status of this stock relative to OSP 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. In Canada, the Cetacean Protection Regulations of 1982, promulgated under the Standing Fisheries Act, prohibit the catching or harassment of all cetacean species. There are insufficient data to determine the population trends for this species. This 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. The status of this stock has been changed from strategic to non-strategic because the estimated annual fishery-related mortality and serious injury is below PBR.

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

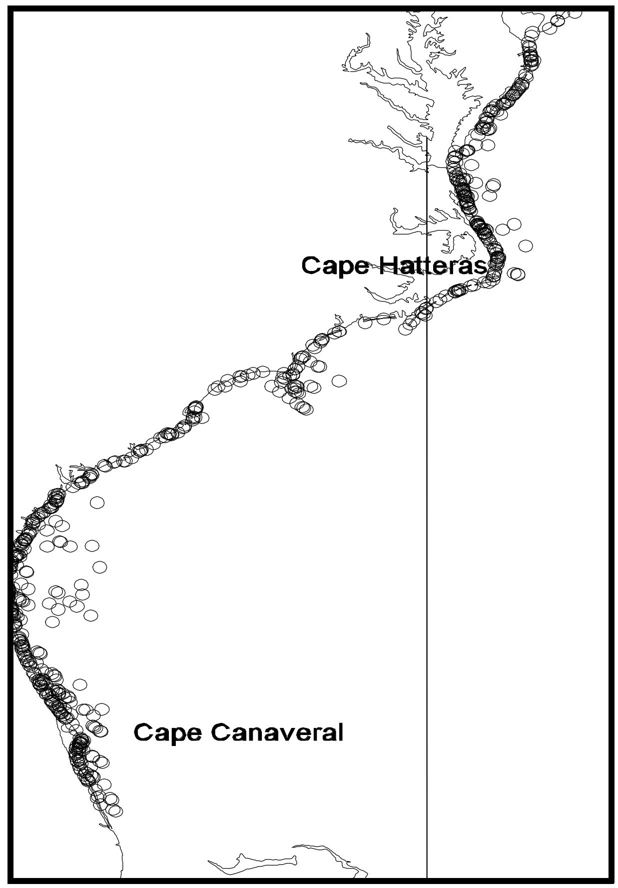

Figure 1. *Sightings of bottlenose dolphins during aerial surveys to the 25 m isobath north of Cape Hatteras during summer 1994, 9 km past the eastern Gulf Stream wall south of Cape Hatteras during winter 1991, and three coastal surveys within one km of shore from New Jersey to mid-Florida during the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

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

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

A working hypothesis for the coastal bottlenose dolphin stock structure postulates that there are local, resident stocks in certain embayments and that transient stocks migrate seasonally into and out of these embayments (Scott et al. 1988). In the Indian-Banana River, 28 of 36 marked bottlenose dolphins either resided in or returned to the river system for a period of at least ten years (Odell and Asper 1990). Eight of the marked dolphins were never positively resighted. None of the marked dolphins were reported from outside the river system; however, search outside of the river system was limited. If the working hypothesis is correct, exchange between resident and transient components of the coastal stock could be sufficient to mask any genetic indicators of stock distinction, even though the stock components might be sufficiently distinct to respond differently to population pressures. Additional, recent information, suggests that more than one stock does exist along the mid-Atlantic coast (summarized in Hohn 1997).

POPULATION SIZE

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

An aerial line-transect survey was conducted during February-March 1991 in the coastal area south of Cape Hatteras. Sampling transects extended orthogonally from shore out to approximately 9 km past the western wall of the Gulf Stream into waters as deep as 140 m, and the area surveyed extended from Cape Hatteras to mid-Florida (Blaylock and Hoggard 1994). Systematic transects were placed randomly with respect to bottlenose dolphin distribution and approximately 3.3% of the total survey area of approximately 89,900 km^2 was visually searched. Survey transects, area, and dates were chosen utilizing the known winter distribution of the stocks in order to sample the entire coastal population; however, the offshore stock may represent some unknown proportion of the resulting population size estimates. Preliminary estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to the perpendicular distance sighting data. Bottlenose dolphin abundance was estimated to be 12,435 dolphins with coefficient of variation (CV) = 0.18 and the log-normal 95% confidence interval was 9,684-15,967 (Blaylock and Hoggard 1994). An aerial survey was conducted during late January-early March 1995, following nearly the same design as the 1991 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.

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

An aerial survey of the coastal waters within a one km strip along the shore from Sandy Hook to approximately Vero Beach, Florida, was also conducted during July 1994 (Blaylock 1995). Dolphins from the offshore stock are believed unlikely to occur in this area. Observers counted all bottlenose dolphins seen within the one km strip alongshore from

Cape Hatteras to Sandy Hook (northern area) and within the one km strip alongshore south of Cape Hatteras to approximately Vero Beach (southern area). The average of three counts of bottlenose dolphins in the northern area was 927 dolphins (range = 303-1,667) and the average of three counts of bottlenose dolphins in the southern area was 630 dolphins (range = 497-815). The sum of the highest counts in both areas was 2,482 dolphins.

Minimum Population Estimate

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

Current Population Trend

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

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04. 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. PBR for the U.S. Atlantic coastal bottlenose dolphin stock is 25 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

From 1992-1995, one hundred and eighty-nine bottlenose dolphins stranded in waters north of Cape Hatteras (Virginia to Massachusetts) (NMFS, unpublished data). The majority of the strandings within this northern area occurred in Virginia (n = 116, 61%). An unknown number (analysis underway) of these animals have shown signs of entanglement with fishing gear or interactions with fishing activities. In 1993, eight bottlenose dolphins in Virginia and one in Maryland were reported as entangled in fishing gear, but the gear type was not reported (NMFS unpublished data). Signs of interaction with fisheries (entanglement, net marks, missing appendages) were present in 22% of the bottlenose dolphin strandings investigated in North Carolina in 1993 (NMFS unpublished data). In 1994, 1995, and 1 January-August 31, 1996, one hundred and ninety-two, 196, and 154, respectively, strandings were reported in the NMFS southeast region (Florida to North Carolina) (NMFS, unpublished data). In 1994, 24 (12%) showed signs of human interaction, 14 (7% of total strandings) had evidence of entanglement with fishing gear. In 1995, 23 (12%) showed signs of human interaction, 12 (6%) cases had evidence of entanglement with fishing gear. Southeast U.S. Marine mammal stranding records indicated that from 1988-1995 an average of 22 bottlenose dolphins showed signs of human interaction (net marks, entanglement, mutilations, boat strikes, gunshot wounds) annually.

North Carolina stranding records show the highest incidence of fishery interactions from the SE Atlantic Region. North Carolina data from 1993 through 1996 have been examined to better determine the annual percentages of human 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. Of the 230 bottlenose dolphin strandings reported in North Carolina from 1993 to 1996, evidence of fisheries interactions was documented in 67 cases (42% of those cases for which a human interaction determination could be made). In addition, other types of human interaction (*i.e.*: prop cuts, gun shots, etc.) were documented in 17 instances (11% of the total number of cases in which a determination was made) (NMFS, unpublished data).

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

Fishery Information

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

Coastal gillnets operate in different seasons targeting different species in different states throughout the range of this stock. Most nets are staked close to shore, but some are allowed to drift, and nets range in length from 91 m to 914 m. A gillnet fishery for American shad, *Alosa sapidissima,* operates seasonally from Connecticut to Georgia, with nets being moved from coastal ocean waters into fresh water with the shad spawning migration (Read 1994). 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 I.

Observer coverage of the U.S. 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 observer, 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. Hence, this observer program is not covering those components of the coastal gillnet complex responsible for most of the interactions with coastal bottlenose dolphins.

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

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

Gear Type	Effort
Haul seines	222
Purse seines	11,962
Otter trawls, bottom	22,550
Otter trawls, midwater	70

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

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.

There are limited observer data directly linking serious injury and mortality to fisheries (e.g., in the stop net fishery in North Carolina), but the total number of bottlenose dolphins assumed from this stock which stranded showing signs of fishery or human-related mortality exceeded PBR in 1993 and again by mid-1997. 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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HARBOR PORPOISE (*Phocoena phocoena*): Gulf of Maine/Bay of Fundy Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

This stock is found in U.S. and Canadian Atlantic waters. During 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 1995b). During fall (October-December) and spring (March-June), harbor porpoises are widely dispersed from North Carolina to Maine, where the density is much lower than during the summer. No specific migratory routes to the northern Gulf of Maine/lower Bay of Fundy region have been documented. Harbor porpoises are seen from near the coastline into the middle of the Gulf of Maine (>200 m deep) in both spring and fall. During winter (January to February), intermediate densities of harbor porpoises are in waters off New Jersey to North Carolina, and low densities are found in waters off New York to New Brunswick, Canada as documented by sighting surveys, strandings, and takes reported by NMFS observers in the Sea Sampling Program. 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, organochlorine contaminants, and life history parameters 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), was estimated using the direct-duplicate method (Palka 1995a) and variability was estimated using bootstrap re-sampling methods. Potential biases not explicitly

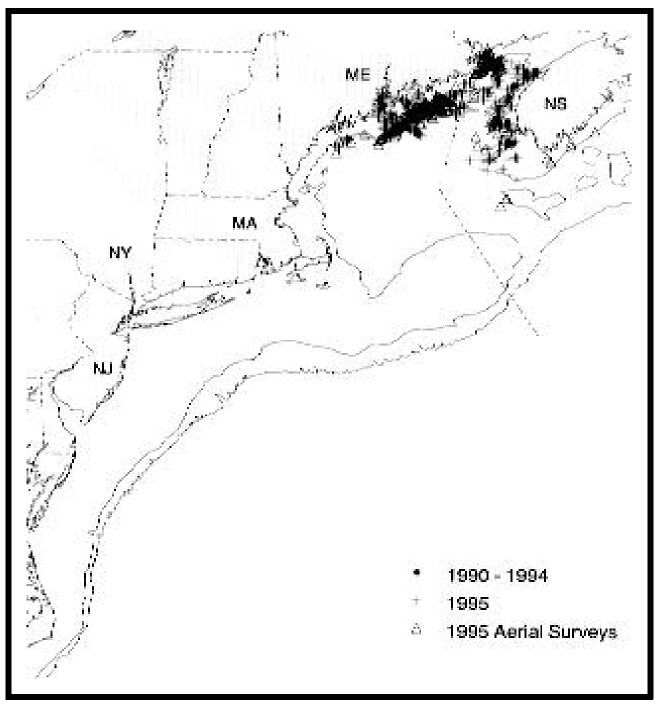

Figure 1. *Distribution of harbor porpoise sightings from NEFSC shipboard and aerial surveys during the summer in 1990-1995. Isobaths are at 100 m and 1,000 m.*

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 western North Atlantic harbor porpoises have not been estimated due to lack of data, several attempts have been made to estimate potential population growth rates. Barlow and Boveng (1991), who used a re-scaled human life table, estimated the upper bound of the annual potential growth rate to be 9.4%. Woodley and Read (1991) used a re-scaled Himalayan tahr life table to estimate 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.* (1994) used a Monte Carlo method to calculate a distribution of growth rates, which indicated that the potential growth rate is unlikely to be greater than 10% per year. The median of this distribution is approximately 4%, but, it is not known whether this is the best estimate (Palka 1994).

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 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

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. However, in recent years it is believed to have nearly stopped (Polacheck 1989).

Harbor porpoises have been taken in U.S. and Canadian fishing weirs. No harbor porpoise takes have been documented in U.S. fishing weirs. In the Bay of Fundy weirs are presently operating, where 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).

Recently, Gulf of Maine/Bay of Fundy harbor porpoises takes have been documented in the U.S. New England multispecies sink gillnet, Mid-Atlantic coastal gillnet, and Atlantic pelagic drift gillnet fisheries, and in the Canadian Bay of Fundy sink gillnet fishery.

Most of the harbor porpoise takes from U.S. fisheries are from the New England multispecies sink gillnet fishery, where the average annual 1990-1995 estimate of mortality is 1,833 (CV=0.12). Bycatch from the Mid-Atlantic coastal gillnet fishery is presently being estimated. One harbor porpoise was observed taken from the 1991-1995 Atlantic pelagic drift gillnet fishery, resulting in an average annual fishery-related mortality of 0.5 (CV=0.60).

Canadian total harbor porpoise by-catch in the Bay of Fundy sink gillnet fishery was thought to be low, based on casual observations and discussions with fishermen. The estimated harbor porpoise by-catch in 1986 was 94-116 and in 1989 it was 130 (Trippel *et al.* 1996). After an observer program was implemented in 1993, it was estimated 424 harbor porpoises were taken in 1993, between 80 and 120 were taken in 1994, and 87 in 1995 (Trippel *et al.* 1996).

Total annual estimated average U.S. fishery-related mortality and serious injury to this stock during 1990-1995 was 1,833 harbor porpoises (CV = 0.12). This is probably an underestimate because it does not include fishery-related mortality and serious injury associated with the U.S. Atlantic coastal gillnet fishery.

Fishery Information

Recent data on 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 provides observer coverage of vessels fishing south of Cape Hatteras.

Recent bycatch has been observed by NMFS Sea Samplers in the U.S. New England multispecies sink gillnet, Mid-Atlantic coastal gillnet, Atlantic drift gillnet, and North Atlantic bottom trawl fisheries, and the Canadian Bay of Fundy 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 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% and 5% for years 1990 to 1995, respectively. There were 310 harbor porpoise mortalities related to this fishery observed between 1990 and 1995 and one was released alive uninjured. Annual estimates of harbor porpoise by-catch in the New England multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Estimated annual by-catch (CV in parentheses) from this fishery during 1990-1995 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), and 1400 in 1995 (0.27) (Bisack, in press). Average estimated harbor porpoise mortality and serious injury in the New England multispecies sink gillnet fishery during 1990-1995 was 1,833 (0.12). These estimates include a correction factor for the under-recorded number of by-caught animals that occurred during unobserved hauls on trips with observers on the boat, when applicable. Need for such a correction became evident following re-analysis of data from the sea sampling program indicating that for some years by-catch rates from unobserved hauls were lower than that for observed hauls. Further analytical details are given in Palka (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. By-catch in the northern Gulf of Maine occurs primarily from June to September; while in the southern Gulf of Maine by-catch occurs from January to May and September to December.

There is no evidence of differential mortality in U.S. or Canadian gillnet fisheries by age or sex, although there is substantial inter-annual variation in the age and sex composition of the by-catch (Read and Hohn 1995).

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. 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 with pingers that were not in the experiment (Table 2). During 1995 to 1996, experimental fisheries were conducted where all nets in a designated area 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 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. All takes from pingered nets were added directly to the estimated total bycatch for the rest of that year in the rest of the fishery.

Observer coverage of the U.S. Atlantic coastal gillnet fishery was initiated by the NEFSC Sea Sampling program in July, 1993; and from July to December 1993, 20 trips were observed. 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. Percent coverage by the program is unknown, but it is believed to be low. No harbor porpoises were taken in observed trips during 1993 and 1994. During 1995 six harbor porpoises were observed taken (Table 2). Polacheck *et al.* (1995) reported one incidental take in shad nets in the York River, Virginia. In general, strandings along U.S. Atlantic beaches suggest that harbor porpoises are taken in the Virginia shad fishery and other coastal gillnet fisheries (Read 1994).

Vessels in the 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. This fishery is active in New England waters in all seasons. One harbor porpoise mortality was observed in this fishery between 1989 and 1995. This take occurred in February 1992 east of Barnegatt Inlet, New York at the continental shelf break. The animal was clearly dead prior to being taken by the trawl, because it was severely decomposed and the tow duration of 3.3 hours was insufficient to allow extensive decomposition; therefore, there is no estimated by-catch for this fishery.

The estimated total number of hauls in the Atlantic 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 and 1995 there were 11 and 12 vessels, respectively, in the fishery (Table 2). The estimated number of hauls in 1991, 1992, 1993, 1994 and 1995 were 233, 243, 232, 197 and 164 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 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 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 logbooks. Variances were estimated using bootstrap re-sampling techniques (Bisack, in prep.). One harbor porpoise mortality was observed between 1989 and 1995. This by-catch was notable because it occurred in continental shelf edge waters adjacent to Cape Hatteras. Estimated annual fishery-related mortality (CV in parentheses) attributable to this fishery was 0.7 in 1989 (7. 00), 1.7 in 1990 (2.65), 0.7 in 1991 (1.00), 0.4 in 1992 (1.00), 1.5 in 1993 (0.34), 0 in 1994 and 0 in 1995. Average estimated harbor porpoise mortality and serious injury in the Atlantic pelagic drift gillnet fishery during 1991-1995 was 0.5 (0.37) (Table 2).

The Canadian gillnet fishery occurs mostly in the western portion of the Bay of Fundy during the summer and early autumn months, when the density of harbor porpoises is highest there. Polacheck (1989) reported there were 19 gillnetters active in 1986, 28 active in 1987, and 21 in 1988. An observer program implemented in the summer of 1993 provided a total by-catch estimates of 424 harbor porpoises. No measure of variability was estimated. The observer program was expanded in 1994 and the by-catch was estimated to be between 80-120 harbor porpoises where the fishing fleet consisted of 28 vessels (Trippel *et al.* 1996). In 1995, 89% of the fishing trips were observed, all in the Swallowtail region. 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 1995, due to groundfish quotas being exceeded, the gillnet fishery was closed during July 21 to August 31, 1995. Approximately 30% of the observed trips used pingered nets. During 1996, the Canadian gillnet fishery was closed from August 20 to September 30, 1996 (E. Trippel, pers. comm.).

Some harbor porpoises are caught in Canadian and U.S. weirs in a fishery which occurs from May to September each year. Weirs are found along the southwestern shore of the Bay of Fundy, and scattered along the western Nova Scotia and northern Maine coasts. There were 180 active weirs in the western Bay of Fundy and 56 active weirs in Maine in 1990 (Read 1994).

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
New England Multispecies Sink Gillnet	90-95	349	Obs. Data Weighout	.01, .06, .07, .05, .07, .05	17, 47, 51[3], 53[3], 99[3], 43[3]	2900, 2000, 1200[3], 1400[3], 2100[3], 1400[3]	.32, .35, .21, .18, .18, .27	1833 (.12)
Pelagic Drift Gillnet	91-95	1994=11[4] 1995=12	Obs. Data Logbook	.20, .40, .42, .87, .99	0, 0, 1, 0, 0	0.7[5], 0.4, 1.5, 0, 0	1.00,1.00, 0.34, 0, 0	0.5 (.37)
Mid-Atlantic Coastal Sink Gillnet	93-95		Obs. Data Weighout	20, 221, 382	0, 0, 6[6]			
TOTAL								1834 (.12)

[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 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] The observer coverage for the sink gillnet fishery is measured in trips, and for the pelagic drift gillnet fishery the unit of effort is a set. Assessments for the mid-Atlantic coastal gillnet fishery have not been completed. The number of trips sampled by the NEFSC Sea Sampling Program are reported here.

[3] Harbor porpoise taken on observed pinger trips were added directly to the estimated total bycatch for that year. There were 10, 33, 44, and 0 observed harbor porpoise takes on pinger trips from 1992 to 1995, respectively. In addition, there were nine observed harbor porpoise takes in 1995 on trips dedicated to fish sampling versus marine mammals (Bisack, in press).

[4] 1994 and 1995 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. This method is described in Northridge (1996). In 1994 and 1995, observer coverage increased substantially, and bycatch rates were not pooled for this period (Bisack, in prep).

[6] Harbor porpoise bycatch estimates for the mid-Atlantic coastal sink gillnet fishery have not been finalized. They are expected in the marine mammal stock assessment report next year.

Other Mortality

Sixty-four harbor porpoise strandings were reported from Maine to North Carolina between January and June, 1993. Fifty of those harbor porpoises were reported stranded in the U.S. Atlantic region from New York to North Carolina between February and May. Many of the carcasses recovered in this area during this time period had cuts and body damage suggestive of net marking (Haley and Read 1993). Five out of eight carcasses and fifteen heads from the strandings that were examined showed signs of human interactions (net markings on skin and missing flippers or flukes). Decomposition of the remaining animals prevented determination of the cause of death. Earlier reports of harbor porpoise entangled in gillnets in Chesapeake Bay and along the New Jersey coast and reports of apparent mutilation of harbor porpoise carcasses, raised concern that the 1993 strandings were related to a coastal net fishery, such as the American shad coastal gillnet fishery (Haley and Read 1993). Between January and May 1994, 45 harbor porpoises were found stranded along the beaches from North Carolina to New York (Smithsonian stranding database 1996).

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

Other potential human-induced factors that may be affecting this harbor porpoise population include high levels of contaminants in their tissues and increased ship activity. Of particular concern are high levels of polychlorinated biphenyls (PCBs) and other lipophilic organochlorines in their tissues (Gaskin *et al.* 1983). Concentrations of organochlorine contaminants from 110 Gulf of Maine/Bay of Fundy harbor porpoises were recently measured (Westgate 1995). PCB levels, the most prominent contaminant, and DDT levels were both higher in Gulf of Maine/Bay of Fundy harbor porpoises than in Gulf of St. Lawrence and Newfoundland harbor porpoises. The recent levels in Gulf of Maine/Bay of Fundy harbor porpoises are much lower than that found in animals ten years ago, as reported in Gaskin *et al.* (1983). Trace metal contaminants were also measured and it was found that mean concentrations of copper, zinc and mercury were similar to values previously reported for harbor porpoises in other regions of the world (Johnston 1995). No obvious pathology has been noted in more than 300 necropsies of harbor porpoises incidentally captured in gillnets in the Bay of Fundy (A. J. Read, unpublished data), but it is not known whether these contaminants have other effects. It has been suggested that increased shipping activity in several coastal bays has caused the disappearance of harbor porpoises in those coastal bays (NEFSC 1992).

STATUS OF STOCK

The status of harbor porpoises, relative to OSP, in the U.S. Atlantic EEZ is unknown. The National Marine Fisheries Service has proposed listing the Gulf of Maine harbor porpoise as threatened under the Endangered Species Act (NMFS 1993). In Canada, the Cetacean Protection Regulations of 1982, promulgated under the standing Fisheries Act, prohibit the catching or harassment of all species of cetaceans. 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). Although the stock structure of the western North Atlantic population is unknown, it is thought that harbor seals found along the eastern U.S. and Canadian coasts represent one population (P. M. Payne, pers. comm.).

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

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

POPULATION SIZE

Two abundance estimates for harbor seals are available (Table 1). Since passage of the MMPA in 1972, the number of seals along the New England coast has increased nearly five-fold. Summer aerial survey haul-out counts along the Maine Coast totaled 28,810 animals (Kenney and Gilbert 1994). This number is considered to be a minimum abundance estimate because it is uncorrected for animals in the water or outside the survey area. Increased abundance of seals in the northeast region has also been documented during aerial and boat surveys of overwintering haul-out sites in southern New England and eastern Long Island (Payne and Selzer 1989; V. Rough, pers. comm.). 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_{best}) and coefficient of variation (CV). Unk=Unknown.

Month/Year	Area	N_{best}	CV
summer 1993	Maine coast	28,810	Unk
August 1992	Bay of Fundy	3,600	Unk

Minimum Population Estimate

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

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are 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 (Wade and Angliss 1997). The minimum population size is 28,810. 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 the stock size of harbor seals is believed to be within OSP. PBR for western North Atlantic harbor seals is 1,729.

ANNUAL HUMAN-CAUSED MORTALITY

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

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

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

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

Fisheries Information

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 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.

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

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

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

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

There are approximately 349 vessels (full and part time) in the New England multispecies sink gillnet fishery (Walden 1996). Observer coverage in terms of trips has been 1%, 6%, 7. 5%, and 5% for 1990 to 1993, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. There were 71 harbor seal mortalities, excluding three animals taken in the 1994 pinger experiment (NMFS unpublished data), observed in the New England multispecies sink gillnet fishery between 1990 and 1993. The estimated annual mortalities (CV in parentheses) in this fishery were 602 in 1990 (0.68), 231 in 1991 (0.22), 373 in 1992 (0.23), and 698 in 1993 (0.19). Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1990-1993 was 476 harbor seals (CV = 0.46). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 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.

Other Mortality

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

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

STATUS OF STOCK

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

There is one gray seal stock in the western North Atlantic; it ranges from New England to Labrador and is centered in the Gulf of St. Lawrence (Katona *et al*. 1993; Davies 1957). This stock is separated by both geography and differences in the breeding season from the eastern Atlantic stock (Bonner 1981). The western Atlantic stock is distributed and breeds principally in eastern Canadian waters; however, small numbers of animals and pupping have been observed on several isolated islands along the Maine coast and in Nantucket-Vineyard Sound, Massachusetts (Katona *et al*. 1993; Rough 1995; J. R. Gilbert, pers. comm.).

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 (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 2,035 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_{best}) and coefficient of variation (CV). Unk=unknown.

Month/Year	Area	N_{best}	CV
1986	Sable Island	100,000 to 130,000	unk
1993	Sable Island and Gulf of St. Lawrence	143,000	unk
1993	Maine coast	500-1000	unk
Apr-May 1994	Muskeget Island and Monomoy, MA	2,035	unk

Minimum Population Estimate

The minimum population estimate for U.S. waters, based on uncorrected total counts (see above), is 2,035 gray seals.

Current Population Trend

Gray seal abundance is likely increasing in the U.S. Atlantic Exclusive Economic Zone (EEZ), but the 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.

A winter breeding colony 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.

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 (Wade and Angliss 1997). The minimum population size is 2,035 (CV=unk). 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 gray seals are within OSP. PBR for the western North Atlantic gray seal is 122.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Gray seals, like harbor seals, were hunted for bounty in New England waters until the late 1960's. This hunt may have severely depleted this stock in U.S. waters (Rough 1995).

Researchers and fishery observers have documented incidental mortality in several fisheries in recent years, particularly within the Gulf of Maine. There were three records of incidental catch of gray seals in the 1989-1993 Northeast Fisheries Science Center (NEFSC) Sea Sampling database. All occurred in 1993 (February, March, and May) in the sink gillnet fishery. Two records were from the Gulf of Maine, and the third, in May, was from SE of Block Island. In addition, V. Rough (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). There are 79 records of stranded gray seals in the Northeast Marine Mammal Stranding Network database for 1989-1993.

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

An unknown number of gray seals have been taken in Newfoundland and Labrador, Gulf of St. Lawrence, and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy herring weirs (Read 1994). In addition to incidental catches, some mortalities (e.g., seals trapped in herring weirs) were the result of direct shooting, and there were culls of about 1,700 animals annually during the 1970's and early 1980's on Sable Island (Anon. 1986).

Because of fishermen's concerns regarding gray seal predation on economically important fish stocks and transmission of the cod worm, Canada now has an open season (March-December) on gray seals (J. Conway, pers. comm.). The number of gray seals shot each year is unknown.

Estimated average annual fishery-related mortality and serious injury to this stock in the U.S. Atlantic EEZ during 1990-1993 was 4.5 gray seals (CV = 2.00).

Fishery Information

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

The Canadian Atlantic groundfish gillnet fishery is important and widespread. Many fisherman hold groundfish gillnet licenses but the number of active fishermen is unknown. In 1989, approximately 6,800 licenses were issued to fishermen along the southern coast of Labrador, and northeast and southern coasts of Newfoundland. There were about

3,900 licenses issued in the Gulf of St. Lawrence in 1989, while 659 licenses were issued in the Bay of Fundy and southwestern Nova Scotia.

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

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

Data on current incidental takes in U.S. fisheries are available from several sources. In 1986, NMFS established a mandatory 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.

There are approximately 349 vessels (full and part time) in the New England multispecies sink gillnet fishery (Walden, 1996). Observer coverage in trips has been 1%, 6%, 7. 5%, and 5% for years 1990 to 1993. The fishery has been observed in the Gulf of Maine and in Southern New England. Three mortalities were observed in this fishery in 1993, in winter off the Massachusetts coast. The estimated mortality in 1993 was 18 gray seals (CV = 1.00). Estimated average annual fishery-related mortality and serious injury to this stock during 1990-1993 attributable to this fishery was 4.5 gray seals (CV = 2.00).

STATUS OF STOCK

The status of the gray seal population, relative to OSP, in U.S. Atlantic EEZ waters is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. Recent data indicate that this population is increasing. In New England waters, both the number of pupping sites and pup production is increasing. In Canada they are protected from harassment and intentional killing under the Marine Mammal Regulations, although some aquaculture operators have been authorized to shoot nuisance animals. The total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury in the U.S. Atlantic EEZ does not exceed PBR and this is not a strategic stock.

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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). 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 (Lavigne and Kovacs 1988). The second stock breeds in the White Sea off the coast of the Soviet Union, and the third stock breeds on the West Ice off of eastern Greenland (Lavigne and Kovacs 1988).

Harp seals are highly migratory. Breeding occurs at different times between mid-February and April for each stock. Adults then assemble north of their whelping patches to undergo the annual moult. The migration then continues north to summer feeding grounds. In late September, after a summer of feeding, nearly all adults and some of the immature animals swim southward ahead of the advancing ice en route to winter breeding and pupping grounds.

The extreme southern limit of the harp seal's habitat extends into the U.S. Atlantic Exclusive Economic Zone (EEZ) during winter and spring. The Northeast Marine Mammal Stranding Network reported an annual average of eight harp seals stranded during 1989-92. Strandings increased to between 45-50 per year in 1993-94 and, in addition to Massachusetts, carcasses were recovered in Connecticut, New York, and New Jersey (Rubinstein 1994). The increased number of strandings may indicate a possible shift in distribution or expansion southward into U.S. waters; if so, fishery interactions may increase.

POPULATION SIZE

The total population size of harp seals is unknown; however, 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 mathematically modeling pup production. Harp seal pup production in the 1950s was estimated at 645,000 (Sergeant 1975), decreasing to 225,000 by 1970 (Sergeant 1975). Estimates began to increase at this time and have continued to rise, reaching 478,000 in 1979 (Bowen and Sergeant 1985) and 577,900 in 1990 (Stenson *et al*. 1993).

Roff and Bowen (1983) developed an estimation model to provide a more precise estimate of total population. This technique incorporates recent pregnancy rates and estimates of age-specific hunting mortality (CAFSAC 1992). Total population can be determined by multiplying pup production by a factor between 5.35 and 5.38, giving a total of approximately three million harp seals in 1990.

Shelton *et al*. (1992) applied a harp seal estimation model to the 1990 pup production and obtained an estimate of 3.1 million (range 2.7-3.5 million; Stenson 1993).

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

Month/Year	Area	N_{best}	CV
1990	North Atlantic	577,900	unk
1990	North Atlantic	3 million	unk
1990	North Atlantic	3.1 million	unk

Minimum population estimate

Present data are insufficient to calculate the minimum population estimate for U.S. waters. It is estimated there are at least 2.7 million harp seals in Canada.

Current population trend

The population appears to be increasing in U.S. waters, judging from the increased number of stranded harp seals, but the magnitude of the suspected increase is unknown. In Canada, the average annual growth rate has been estimated to be about 7% (Stenson 1993).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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 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 (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 is unknown because the minimum population size in U.S. waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no records of harp seals in the NEFSC 1989-1993 Sea Sampling by-catch database; however, 40-50 seals which identified by observers as harbor seals in spring 1994 may have, in fact, been harp seals. Biological and photographic data from takes are under review.

An unknown number of harp seals have been taken in Newfoundland and Labrador groundfish gillnets (Read 1994). Harp seals are being taken in Canadian lumpfish and groundfish gillnets, and trawls, but estimates of total removals have not been calculated to date (Anon. 1994). Harp seals have been commercially hunted since the mid-1800's in the Canadian Atlantic (Stenson 1993). A total allowable catch (TAC) of 200,000 harp seals was set for the large vessel hunt in 1971. The TAC varied until 1982 when it was set at the current level of 186,000 seals (Stenson 1993). Catches ranged from 53,000 to 95,000 between 1988-1992 (Stenson 1993).

Fishery Information

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

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

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

STATUS OF STOCK

The status of the harp seal stock, relative to OSP, in the U.S. 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. In Canada they are protected from harassment and intentional killing is controlled under the Marine

Mammal Regulations. 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 U.S. Atlantic EEZ is unknown, but believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

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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). 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). One stock, which whelps off the coast of eastern Canada, is divided into two breeding herds which breed on the pack ice. The Front herd breeds off the coast of Newfoundland and Labrador and the Gulf herd breeds in the Gulf of St. Lawrence. The second stock breeds on the White Ice off eastern Greenland, and the third stock occurs in the Davis Strait.

Hooded seals are a highly migratory species. Breeding occurs at the same time in February for each stock. Adults from all stocks then assemble in the Denmark Strait to moult between June and August (King 1983), and following this, the seals disperse widely. Some move south and west around the southern tip of Greenland, and then north along the west coast of Greenland. Others move to the east and north between Greenland and Svalbard during late summer and early fall (Lavigne and Kovacs 1988). Little else is known about the activities of hooded seals during the rest of the year until they assemble again in February for breeding.

Hooded seals are rarely found in the U.S. Atlantic Exclusive Economic Zone. Small numbers of hooded seals at the extreme southern limit of their range occur in the winter and spring seasons. The Northeast Marine Mammal Stranding Network reports an average of seven hooded seals stranded annually from 1989-92. In 1993-94, strandings increased to between 19-24 a year and carcasses were recovered from Massachusetts, Connecticut, and New York (Rubinstein 1994). The increased number of strandings may indicate a possible shift in distribution or range expansion southward into U.S. waters; if so, fishery interactions may increase.

POPULATION SIZE

The number of hooded seals in the western North Atlantic is unknown. Seasonal abundance estimates are available based on a variety of methods including aerial surveys. These methods often include surveying the whelping concentrations and mathematically modeling the pup production. Hooded seal pup production between 1966 and 1971 was estimated between 27,000 and 41,000 annually (Benjaminsen and Oritsland 1975). Estimated pup production dropped to 26,000 hooded seal pups in 1978 (Winters 1978). Pup production estimates began to increase after 1978, reaching 62,000 by 1984 (Hay *et al*. 1985), and rose to 82,000 in 1990 (Hammill *et al*. 1992). No recent population estimate is available, but assuming a ratio of pups to total population of 1:5, pup production in the Gulf and Front herds would represent a total population of approximately 400,000-450,000 hooded seals (Stenson 1993). It appears that the number of hooded seals is increasing.

Minimum population estimate

Present data are insufficient to calculate the minimum population estimate for U.S. waters. It is estimated that there are approximately 400,000 hooded seals in Canadian waters.

Current population trend

The population appears to be increasing in U.S. Atlantic EEZ, judging from stranding records, although the actual magnitude of this increase is unknown. The Canadian population appears to be increasing but, because different methods have been used over time to estimate population size, the magnitude of this increase has not been quantified.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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 (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 is unknown because the minimum population size in U.S. waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no records of fishery-related mortality to hooded seals in the NEFSC 1989-1993 Sea Sampling database.

An unknown number of hooded seals have been taken in Newfoundland and Labrador groundfish gillnets (Read 1994). The following summary on the hooded seal fishery is taken from Stenson (1993). In Atlantic Canada, hooded seals have been commercially hunted at the Front since the late 1800's. In 1974 total allowable catch (TAC) was set at 15,000, and reduced to 12,000 in 1983 and to 2,340 in 1984. In 1991 the TAC was increased to 15,000. A TAC of 8,000 was set for 1992 and 1993. From 1974 through 1982, the average catch was 12,800 animals, mainly pups. Since 1983 catches ranged from 33 in 1986 to 6,321 in 1991, with a mean catch of 1,116 between 1983 and 1992.

Hunting in the Gulf of St. Lawrence has been prohibited since 1964. No commercial hunting of hooded seals is permitted in the Davis Strait.

The total fishery-related mortality and serious injury for this stock is very low relative to the population size, especially in Canadian waters.

Fishery Information

No hooded seals have been taken incidentally in U.S. waters.

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

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

Hooded seals are being taken in Canadian lumpfish and groundfish gillnets and trawls; however, estimates of total removals have not been calculated to date.

STATUS OF STOCK

The status of hooded seals relative to OSP in U.S. Atlantic EEZ is unknown. They are not listed as threatened or endangered under the Endangered Species Act. In Canada they are protected from harassment and intentional killing is controlled under the Marine Mammal Regulations. This mortality 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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SPERM WHALE (*Physeter macrocephalus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sperm whales are found throughout the world's oceans in deep waters from between about 60° N and 60° S latitudes (Leatherwood and Reeves 1983; Rice 1989). There has been speculation, based on year round occurrence of strandings, opportunistic sightings, and whaling catches, that sperm whales in the Gulf of Mexico may constitute a distinct stock (Schmidly 1981), but there is no information on stock differentiation. Seasonal aerial surveys confirm that sperm whales are present in the northern Gulf of Mexico in all seasons, but sightings are more common during the summer months (Mullin et al. 1991; Hansen *et al*. 1996).

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of sperm whales by survey year [coefficient of variation (CV) in parentheses] was 143 in 1991 (0.58), 931 in 1992 (0.48), 229 in 1993 (0.52), and 771 in 1994 (0.42) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of sperm whales for all surveys combined was 530 (CV = 0.31) (Hansen et al. 1995).

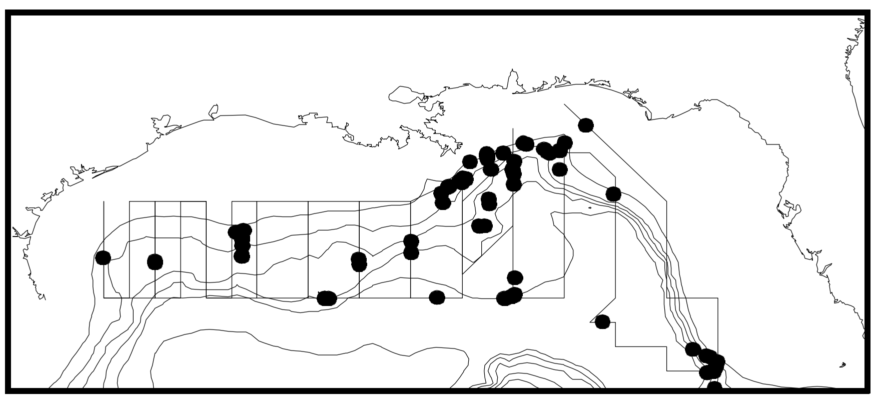

Figure 1. *Distribution of sperm whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two ship surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 from the 1991-1994 average abundance estimate of 530 sperm whales (CV = 0.31) (Hansen et al. 1995) and is 411 sperm whales.

Current Population Trend

No trend was discernable in the average annual abundance estimates. All of the log-normal 95% confidence intervals of the annual estimates overlap, indicating that the estimates were not significantly different at that level. The variation in abundance estimates may represent inter-annual variation in distribution, rather than a change in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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 0.1 because sperm whales are an endangered species. PBR for this stock is 0.8 sperm whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

A commercial fishery for sperm whales operated in the Gulf of Mexico during the late 1700's to the early 1900's, but the exact number of whales taken is not known (Townsend 1935).

The level of current, direct, human-caused mortality and serious injury of sperm whales in the northern Gulf of Mexico is unknown, but available information indicates there likely is little, if any, fisheries interaction with sperm whales in the northern Gulf of Mexico.

There were no documented strandings of sperm whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to sperm whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

Other Mortality

A total of nine sperm whale strandings were documented in the northern Gulf of Mexico during 1987-1994. One of the whales had deep, parallel cuts posterior to the dorsal ridge that were believed to be caused by the propeller of a large vessel. This trauma was assumed to be the proximate cause of this stranding.

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

STATUS OF STOCK

Stock size is considered to be low relative to OSP and the species is therefore listed as endangered under the Endangered Species Act (ESA). There are insufficient data to determine population trends. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant; however, because this species is listed as endangered and there is presently no recovery plan in place, any fishery-related mortality would be unlawful. The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because the sperm whale is listed as an endangered species under the ESA.

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BRYDE'S WHALE (*Balaenoptera edeni*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bryde's whales are considered the tropical and sub-tropical baleen whale of the world's oceans. In the western Atlantic, Bryde's whales are reported from off the southeastern United States and the southern West Indies to Cabo Frio, Brazil (Leatherwood and Reeves 1983). It is postulated that the Bryde's whales found in the Gulf of Mexico may represent a resident stock (Schmidly 1981; Leatherwood and Reeves 1983), but there is no information on stock differentiation. Most sightings of Bryde's whales have occurred during the spring-summer months (Hansen et al. 1995; Hansen *et al*. 1996), but strandings have occurred throughout the year (Jefferson et al. 1992).

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. The estimated abundance of Bryde’s whales by survey year was 218 in 1991 (coefficient of variation, CV = 1.01) and zero in 1992, 1993, and 1994 (Hansen et al. 1995). Survey effort-weighted estimated average abundance of Bryde's whales for all surveys combined was 35 (CV = 1.10) (Hansen et al. 1995) and was based on only three sightings, all of which occurred in 1991.

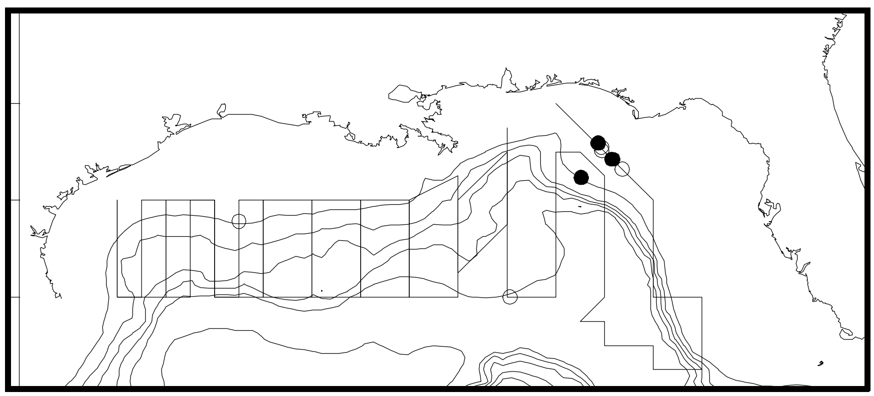

Figure 1. *Distribution of Bryde’s whale sightings (filled circles) and unidentified balaenopterid whales (unfilled circles) during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two ship surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 based on the 1991-1994 average estimated abundance of Bryde's whales which was 35 (CV = 1.10) (Hansen et al. 1995) and is 17 Bryde’s whales.

Current Population Trend

The abundance estimates decreased to zero for survey years 1992-1994 because Bryde's whales were not sighted during vessel surveys those years. This could be due to chance rather than to a decrease in population size and the result of a relatively small population size and low sampling intensity or it could be due to inter-annual variation in distribution.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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. The resulting PBR for this stock is 0.2 Bryde's whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of Bryde's whales in the northern Gulf of Mexico is unknown, but available information indicates there is little fisheries interaction with Bryde's whales in the northern Gulf of Mexico. There was one report of a Bryde's whale entangled in line, but the line was removed and the animal released alive.

There were no documented strandings of Bryde's whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to Bryde's whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

Other Mortality

No human-caused mortality has been reported for this stock.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant; therefore, this is not a strategic stock.

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CUVIER'S BEAKED WHALE (*Ziphius cavirostris*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Cuvier's beaked whales are distributed throughout the world's oceans except for the polar regions (Leatherwood and Reeves 1983; Heyning 1989). Strandings have occurred in all months along the United States east coast (Schmidly 1981) and have been documented throughout the year in the Gulf of Mexico. Strandings of Cuvier's beaked whales along the west coast of North America, based on skull characteristics, are thought to represent members of a panmictic population (Mitchell 1968), but there is no information on stock differentiation in the Gulf of Mexico and nearby waters.

Beaked whales were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico (Hansen *et al*. 1996). Some of the aerial survey sightings may have included Curvier's beaked whale, but identification of beaked whale species from aerial surveys is problematic.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. The estimated abundance [coefficient of variation (CV) in parentheses] by survey year was zero in 1991 and 1992, 70 in 1993 (0.63), and 38 in 1994 (0.80) (Hansen et al. 1995). Survey effort-weighted estimated average abundance average abundance of Cuvier's beaked whales was 30 (CV = 0.50) (Hansen et al. 1995). The estimated abundance of Curvier's beaked whales is probably low because only sightings of beaked whales which could be positively identified to species were used.

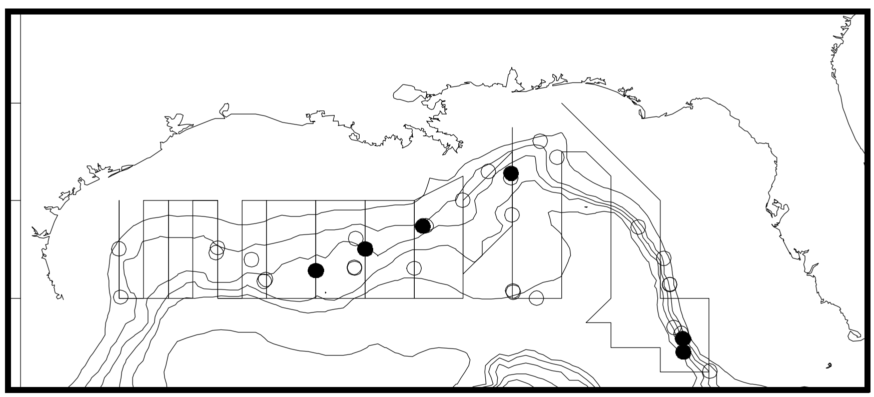

Figure 1. *Distribution of Curvier's beaked whale sightings (filled circles) and unidentified beaked whale sightings (unfilled circles) during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population estimate was based on average estimated abundance of Cuvier's beaked whales for all surveys combined which was 30 whales (CV = 0.50) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 20 Cuvier's beaked whales.

Current Population Trend

The abundance estimates were zero in 1991 and 1992, and then increased for 1993 and 1994. Cuvier's beaked whales were not sighted during the 1991 and 1992 vessel surveys. This could be due to chance given the small estimated population size and sampling intensity or inter-annual variation in distribution, rather than a change in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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 this stock is 0.2 Cuvier's beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Cuvier's beaked whales were taken occasionally in a small, directed fishery for cetaceans that operated out of the Lesser Antilles (Caldwell and Caldwell 1971).

The actual level of past or current, direct, human-caused mortality of Cuvier's beaked whales in the northern Gulf of Mexico is unknown, but there have been no reports of fishery-related mortality or serious injury to beaked whales by U.S. fisheries in the Gulf of Mexico. Available information indicates there likely is little, if any, fisheries interaction with Cuvier's beaked whales in the northern Gulf of Mexico.

There were no documented strandings of Cuvier's beaked whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to Cuvier's or any beaked whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. Total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant; therefore, this is not a strategic stock.

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BLAINVILLE'S BEAKED WHALE (*Mesoplodon densirostris*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Only three species of *Mesoplodon* are known, from strandings and/or sightings, to occur in the Gulf of Mexico (Jefferson et al. 1992; Hansen et al. 1995). These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*), and Sowerby's beaked whale (*M. bidens*). The occurrence of Sowerby's beaked whale in the Gulf of Mexico is considered extralimital because there is only one known stranding of this species in the Gulf of Mexico (Bonde and O'Shea 1989) and because it normally occurs in northern temperate waters of the North Atlantic (Mead 1989).

Identification of *Mesoplodon* species at sea is problematic; therefore, nearly all sightings of these species are identified as beaked whales and may include sightings of *Ziphius cavirostris* that were not identified as such. Beaked whales were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico (Hansen *et al*. 1996).

Blainville's beaked whales appear to be widely but sparsely distributed in warm temperate and tropical waters of the world's oceans (Leatherwood et al. 1976; Leatherwood and Reeves 1983). Strandings have occurred along the northwestern Atlantic coast from Florida to Nova Scotia (Schmidly 1981), and there have been two documented strandings of this species in the northern Gulf of Mexico and one sighting (Jefferson et al. 1992; Hansen et al. 1995). There is no information on stock differentiation.

POPULATION SIZE

Estimates of abundance of beaked whales were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Survey effort-weighted estimated average abundance of beaked whales not identified to species for all surveys combined was 117 (coefficient of variation, CV = 0.38) (Hansen et al. 1995). Estimated beaked whale abundance (CV in parentheses) by survey year was 129 in 1991 (0.78),18 in 1992 (1.27), 53 in 1993 (0.78), and 287 in 1994 (0.48) (Hansen et al. 1995). These estimates may also include an unknown number of Cuvier's beaked whales (*Ziphius cavirostris*) and abundance of Blainville's beaked whale cannot be estimated due to uncertainty of species identification at sea.

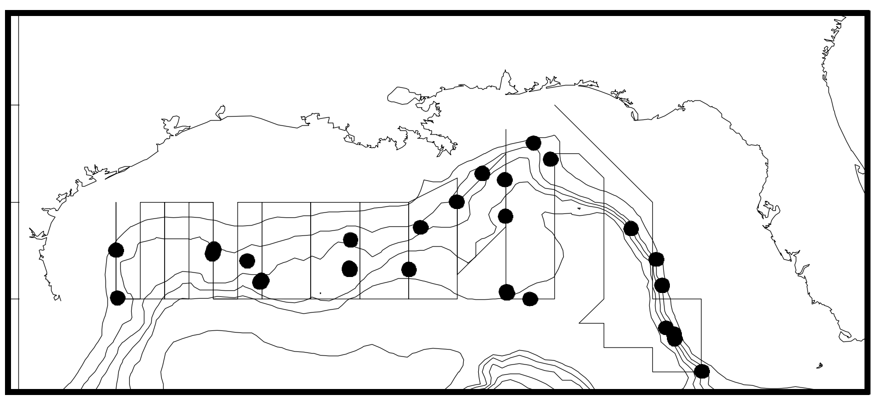

Figure 1. *Distribution of beaked whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

A minimum population estimate was not calculated because of uncertainty of species identification of sightings.

Current Population Trend

The abundance estimates of beaked whales for 1991-1993 were lower than 1994, but there was considerable overlap of the log-normal 95% confidence intervals, which indicates the estimates were not significantly different at that level. Any differences in abundance estimates could be due to chance given the small estimated population size and sampling intensity or a change in distribution, rather than a change in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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 Blainville's beaked 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 beaked whales in the northern Gulf of Mexico is unknown, but there have been no documented reports of fishery-related mortality or serious injury to beaked whales by U.S. fisheries in the Gulf of Mexico. Available information indicates there likely is little, if any, fisheries interaction with beaked whales in the northern Gulf of Mexico.

There were no documented strandings of beaked whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. Although PBR cannot be calculated, the total known fishery-related mortality and serious injury for this stock is zero and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant; therefore, this is not a strategic stock.

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July 1995

GERVAIS' BEAKED WHALE (*Mesoplodon europaeus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Only three species of *Mesoplodon* are known, from strandings and/or sightings, to have occurred in the Gulf of Mexico (Jefferson et al. 1992; Hansen et al. 1995). These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*), and Sowerby's beaked whale (*M. bidens*). The occurrence of Sowerby's beaked whale in the Gulf of Mexico is considered extralimital because there is only one known stranding of this species in the Gulf of Mexico (Bonde and O'Shea 1989), and because it normally occurs in northern temperate waters of the North Atlantic (Mead 1989). Identification of *Mesoplodon* species at sea is problematic. Therefore, nearly all sightings of these species are identified as beaked whales and may include sightings of *Ziphius cavirostris* which were not identified as such. Beaked whales were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico (Hansen *et al*. 1996).

Strandings of Gervais' beaked whales have occurred along the northwestern Atlantic coast from Florida to New York (Mead 1989), and there have been at least ten documented strandings of this species in the Gulf of Mexico (Jefferson et al. 1992). There is no information on stock differentiation.

POPULATION SIZE

Estimates of abundance of beaked whales were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Survey effort-weighted estimated average abundance of beaked whales not identified to species for all surveys combined was 117 (coefficient of variation, CV = 0.38) (Hansen et al. 1995). Estimated beaked whale abundance (CV in parentheses) by survey year was 129 in 1991 (0.78),18 in 1992 (1.27), 53 in 1993 (0.78), and 287 in 1994 (0.48) (Hansen et al. 1995). These estimates may also include an unknown number of Cuvier's beaked whales (*Ziphius cavirostris*) and abundance of Gervais' beaked whale cannot be estimated due to uncertainty of species identification at sea.

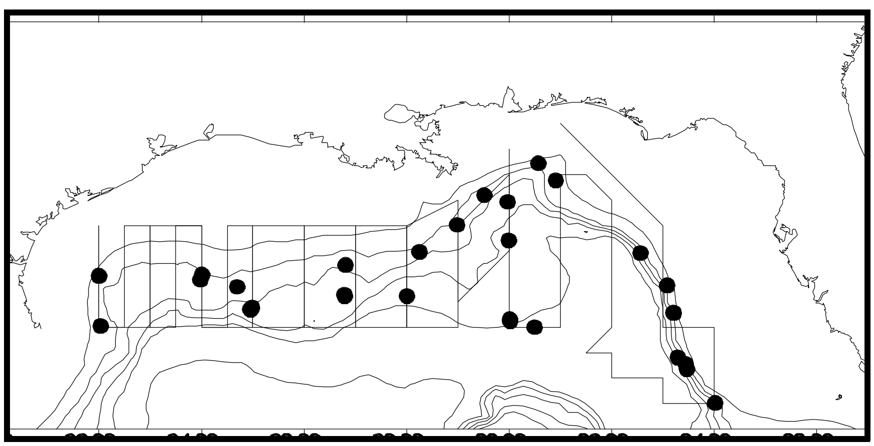

Figure 1. *Distribution of beaked whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

A minimum population estimate could not be not calculated because of uncertainty of species identification of sightings.

Current Population Trend

The abundance estimates of beaked whales for 1991-1993 were lower than 1994, but there was considerable overlap of the log-normal 95% confidence intervals, which indicates the estimates were not significantly different at that level. Any differences in abundance estimates could be due to chance given the small estimated population size and sampling intensity or a change in distribution, rather than a change in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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 Gervais' beaked 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 beaked whales in the northern Gulf of Mexico is unknown, but there have been no documented reports of fishery-related mortality or serious injury to beaked whales by U.S. fisheries in the Gulf of Mexico. Available information indicates there likely is little, if any, fisheries interaction with beaked whales in the northern Gulf of Mexico.

There were no documented strandings of beaked whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

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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.

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 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 human-caused mortality and serious injury is unknown, but it is believed to be insignificant; therefore, this is not a strategic stock.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Gulf of Mexico Outer Continental Shelf Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Gulf of Mexico Outer Continental Shelf (OCS) bottlenose dolphin stock is assumed to consist of the shallow, warm water bottlenose dolphin ecotype hypothesized by Hersh and Duffield (1990) inhabiting waters over the U.S. OCS in the northern Gulf of Mexico from approximately 9 km seaward of the 18 m isobath to approximately 9 km seaward of the 183 m isobath and from the U.S.-Mexican border to the Florida Keys. The stock range may extend into Mexican and Cuban territorial waters; however, there are no available estimates of either abundance or mortality from those countries. As a working hypothesis, the bottlenose dolphins inhabiting the 0-18 m depth stratum are believed to constitute coastal stocks in the western, northern, and eastern U.S. Gulf of Mexico separate from the OCS stock; however, the OCS stock may overlap with coastal stocks in some areas and may be genetically indistinguishable from those stocks. The OCS stock may be combined with some or all of the coastal stocks when additional data become available.

In addition, the aerial surveys from which the current abundance estimates were derived overlapped the outer continental shelf edge which is believed to be inhabited by the OCS edge and continental slope stock (Fig. 1). This stock is believed to consist of the deep, cold water ecotype described by Hersh and Duffield for the Atlantic (1990). It is not currently possible to differentiate the two ecotypes visually during aerial surveys.

POPULATION SIZE

Preliminary estimates of abundance were derived using distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during Gulf of Mexico regional aerial line-transect surveys in September-October 1992 and 1993 (Blaylock and Hoggard 1994) and 1994 (NMFS unpublished data). Transects providing systematic coverage of the area and assumed to be randomly placed with respect to bottlenose dolphin distribution extended orthogonally from approximately 9 km past the 18 m isobath to approximately 9 km past the 183 m isobath. Approximately 3.3% of the total area was visually sampled. Preliminary analyses provided a bottlenose dolphin abundance estimate of 50,247 dolphins with coefficient of variation (CV) = 0.18. The survey area overlapped with a portion of the area occupied by the OCS edge and continental slope stock which was assumed to occur in waters over the OCS edge and beyond to the seaward limits of the U.S. Exclusive Economic Zone. This would tend to inflate the abundance estimate, but it is not currently possible to estimate the amount of potential bias.

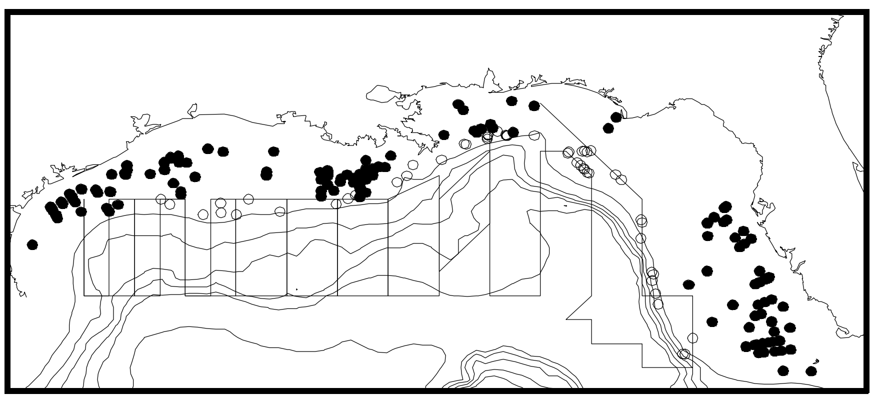

Figure 1. *Sightings of U.S. Gulf of Mexico outer continental shelf (OCS) bottlenose dolphin stock during GOMEX regional aerial surveys (filled circles). Bottlenose dolphin sightings along the OCS edge and continental slope during NOAA Ship Oregon II surveys (unfilled circles), shown for comparison, are believed to be a separate stock. The straight lines show transects during two ship surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population estimate was based on the abundance estimate of 50,247 dolphins (CV = 0.18). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 43,233 bottlenose dolphins.

Current Population Trend

The data are insufficient to determine population trends. Aerial surveys conducted during autumn 1983 and 1985 by the Southeast Fisheries Science Center (SEFSC) produced an abundance estimate of 31,519 bottlenose dolphins (CV = 0.08) for this stock (Scott et al. 1989). This population thus appears to have increased from earlier estimated levels; however, a valid statistical comparison of the historical and present estimated population sizes is not presently possible because of the preliminary nature of the recent population size estimate and the possible biases caused by overlap of the survey area with the OCS edge and continental slope stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04. 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) was specified as 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 this stock is of unknown status. PBR for this stock is 432 bottlenose dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no observed cases of human-caused mortality and serious injury in this stock; however, based on an observed non-lethal take in U.S. Atlantic waters in 1993 in the pelagic longline fishery, this stock may be subject to incidental take resulting in serious injury or mortality. Fishery interactions have been reported to occur between bottlenose dolphins and the longline swordfish/tuna fishery in the Gulf of Mexico (SEFSC unpublished logbook data) and annual fishery-related mortality and serious injury to bottlenose dolphins is estimated to be 2.8 per year (CV = 0.74) during 1992-1993. This could include bottlenose dolphins from the outer continental shelf edge and continental slope stock.

Fishery Information

Annual fishing effort for the shrimp trawl fishery in the U.S. Gulf of Mexico OCS during 1988-1993 averaged approximately 2.58 million hours of tows (CV = 0.07) (NMFS unpublished data). This fishery was monitored by NMFS observers in 1992 and 1993, but less than 1% of the fishing effort was observed (NMFS unpublished data). There have been no reports of incidental mortality or injury associated with the shrimp trawl fishery in this area.

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery. The following estimates were based on observed takes across the Atlantic longline swordfish/tuna fishery (which includes the Gulf of Mexico). All observed takes were used because the species occurs generally throughout the area of the fishery, but observed takes were infrequent in any given region of the fishery. There were no lethal takes of bottlenose dolphins observed or reported in 1992 and 1993, and only one non-lethal take was reported in 1993, which is assumed to have caused serious injury. The estimated level of fishery-related mortality and serious injury for the entire fishery, including waters outside of the Gulf of Mexico, in 1993 was 16 bottlenose dolphins (CV = 0.19). No take was observed in the Gulf of Mexico, but interactions between bottlenose dolphins and this fishery in the Gulf of Mexico have been reported under the Marine Mammal Protection Act Interim Exemption Program (NMFS 1991).

Given the fact that fishery interactions have been reported to occur between bottlenose dolphins and the longline swordfish/tuna fishery in the Gulf of Mexico, a probable level of fishery-related mortality and serious injury rate can be estimated. Under the assumption that the probability of an incidental take is proportional to fishing effort (number of sets), the estimated level of incidental mortality and serious injury partitioned to include only the Gulf of Mexico stock would be 5.5 bottlenose dolphins in 1993 (CV = 0.19). Average annual fishery-related mortality and serious injury during 1992-1993 would be 2.8 bottlenose dolphins (CV= 0.74). This estimate could include dolphins from the OCS edge and continental slope stock.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration in the Gulf of Mexico.

A trawl fishery for butterfish was monitored by NMFS observers for a short period in the 1980's with no records of incidental take of marine mammals (Burn and Scott 1988; NMFS unpublished data), although an experimental set by NMFS resulted in the death of two bottlenose dolphins (Burn and Scott 1988). There are no other data available.

Other Human-Related Mortality or Serious Injury

The use of explosives to remove oil rigs in the portions of the OCS in the western Gulf of Mexico has the potential to cause serious injury or mortality to marine mammals. These activities have been closely monitored by NMFS observers since 1987 (Gitschlag and Hale 1994) and Gitschlag and Herczeg (1994) described the monitoring activities that occurred in 1992. There have been no reports of either serious injury or mortality to bottlenose dolphins (NMFS unpublished data).

STATUS OF STOCK

The status of this stock relative to OSP is not known and the population trend cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. Total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because fishery-related mortality and serious injury does not exceed PBR.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Gulf of Mexico Continental Shelf Edge and Continental Slope Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

This bottlenose dolphin stock is defined as the stock which occupies the outer edge of the U.S. Gulf of Mexico Outer Continental Shelf (OCS) and waters over the continental slope within the U.S. Exclusive Economic Zone (EEZ), from the latitude and longitude of the U.S. EEZ off the U.S.-Mexico border to the latitude of the U.S. EEZ south of Key West, Florida. Close observation by experienced NMFS observers from shipboard surveys conducted throughout much of its range (Fig. 1) indicates that most of the dolphins sighted during ship-based surveys over the continental shelf edge and continental slope were the relatively large and robust dolphins assumed to be of the deep water ecotype hypothesized by Hersh and Duffield (1990). These dolphins were reported to be larger and darker in color than bottlenose dolphins seen over the continental shelf closer to shore (NMFS unpublished data). This stock's range may extend into Mexican and Cuban waters; however, there are no estimates available for bottlenose dolphin abundance or mortality from those countries.

POPULATION SIZE

Preliminary estimates of abundance were derived using distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during shipboard line-transect surveys conducted during the spring of 1992-1994 (Fig. 1). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Average bottlenose dolphin abundance over six surveys was estimated at 5,618 dolphins with coefficient of variation (CV) = 0.26. In this analysis, it was assumed that all of the bottlenose dolphins sighted during the ship-based surveys were of this stock. The survey area overlapped in some areas with the OCS stock which was assumed to occur from approximately 9 km seaward of the 18 m isobath to approximately 9 km seaward of the 183 m isobath; however, the amount of overlap is considered insignificant and its effect on the abundance estimate is not known.

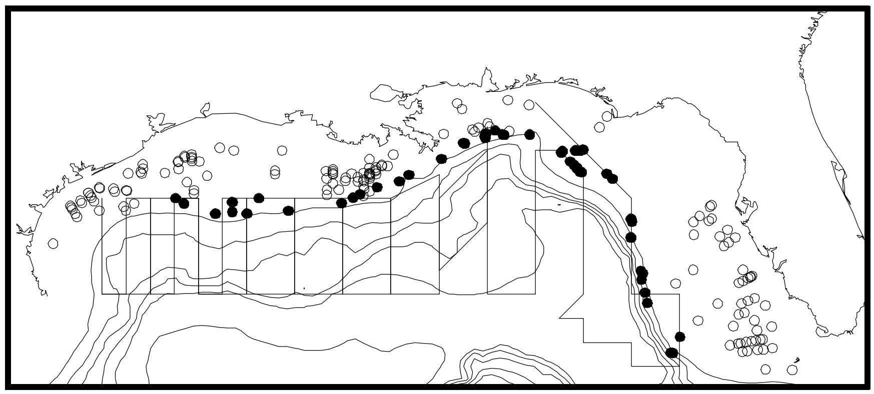

Figure 1. *Distribution of sightings of bottlenose dolphins during NOAA Ship Oregon II marine mammal surveys in the Gulf of Mexico outer continental shelf (OCS) edge and continental slope waters (filled circles). Sightings of the OCS bottlenose dolphin stock made during GOMEX regional aerial surveys (unfilled circles) are shown for comparison. The bottlenose dolphin on the OCS are believed to be a separate stock. The straight lines show transects during two ship surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population estimate was based on the average bottlenose dolphin abundance estimate of 5,618 bottlenose dolphins (CV = 0.26). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 4,530 bottlenose dolphins.

Current Population Trend

The data are insufficient to determine population trends.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates 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 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 this stock is of unknown status. PBR for this stock is 45 bottlenose dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no observed cases of human-caused mortality and serious injury in this stock; however, based on an observed non-lethal take in U.S. Atlantic waters in 1993 in the pelagic longline fishery, this stock may be subject to incidental take resulting in serious injury or mortality. Fishery interactions have been reported to occur between bottlenose dolphins and the longline swordfish/tuna fishery in the Gulf of Mexico [Southeast Fisheries Science Center (SEFSC) unpublished logbook data] and annual fishery-related mortality and serious injury to bottlenose dolphins is estimated to be 2.8 per year (CV = 0.74) during 1992-1993. This estimate could include bottlenose dolphins from the OCS stock.

Fishery Interaction

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. Estimated take was based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take and self-reported incidental take and effort data for the fishery. The following estimates were based on observed takes across the Atlantic longline swordfish/tuna fishery (which includes the Gulf of Mexico). All observed takes were used because the species occurs generally throughout the area of the fishery, but observed takes were infrequent in any given region of the fishery. There were no lethal takes of bottlenose dolphins observed or reported in 1992 and 1993, and only one non-lethal take was reported in 1993, which is assumed to have caused serious injury. The estimated level of fishery-related mortality and serious injury for the entire fishery, including waters outside of the Gulf of Mexico, in 1993 was 16 bottlenose dolphins (CV = 0.19). No take was observed in the Gulf of Mexico, but there are logbook reports of interactions between bottlenose dolphins and this fishery (SEFSC unpublished logbook data).

Given the fact that fishery interactions have been reported to occur between bottlenose dolphins and the longline swordfish/tuna fishery in the Gulf of Mexico, a probable level of fishery-related mortality and serious injury rate can be estimated. Under the assumption that the probability of an incidental take is proportional to fishing effort (number of sets), the estimated level of incidental mortality and serious injury partitioned to include only the Gulf of Mexico stock would be 5.5 bottlenose dolphins in 1993 (CV = 0.19). Average annual fishery-related mortality and serious injury during 1992-1993 would be 2.8 bottlenose dolphins (CV= 0.74). This estimate could include dolphins from the OCS stock.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

A trawl fishery for butterfish was monitored by NMFS observers for a short period in the 1980's with no records of incidental take of marine mammals (Burn and Scott 1988; NMFS unpublished data), although an experimental NMFS set resulted in the death of two bottlenose dolphins (Burn and Scott 1988). There are no other data available.

Other Mortality

No direct or indirect human-caused mortality has been reported for this stock.

STATUS OF STOCK

The status of this stock relative to OSP is not known and the population trend cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. The total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because fishery-related mortality or serious injury does not exceed PBR.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Western Gulf of Mexico Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The western Gulf of Mexico coastal bottlenose dolphin stock has been defined for management purposes as the bottlenose dolphins inhabiting the nearshore coastal waters in the U.S. Gulf of Mexico from the Texas border to the Mississippi River mouth, from shore or presumed bay boundaries to 9.3 km seaward of the 18.3 m isobath (Fig. 1). As a working hypothesis, it is assumed that the dolphins occupying habitats with dissimilar climactic, coastal, and oceanographic characteristics might be restricted in their movements between habitats and, thus, constitute separate stocks. The western coastal area is characterized by an arid to temperate climate, sand beaches, and low fresh water input. The northern coastal stock area which is characterized by a temperate climate, barrier islands, sand beaches, coastal marshes and marsh islands, and has a relatively high level of fresh water input from rivers and streams. The eastern coastal stock area is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches, marsh and mangrove islands, and has an intermediate level of freshwater input.

The stock occurs trans-boundary with Mexico; however, there is no information available for abundance estimation, nor for estimating fishery-related mortality in Mexican waters. The ratio of DDE to DDT was extraordinarily high in tissues of one bottlenose dolphin stranded on the Texas coast (Varanasi et al. 1992), suggesting recent exposure to DDT which is still in use in Mexico.

The Mississippi River outflow may constitute an effective ecological barrier to stock migration at the eastern boundary. This assumption has not been tested and interbreeding may, in fact, occur between this and the northern coastal stock at this boundary; therefore, the definition of this stock may be revised and the stock may be incorporated with the northern coastal stock when more data become available. There are data which suggest that there is considerable alongshore movement by some members of the western coastal stock (NMFS unpublished data), but the extent of this movement is unknown.

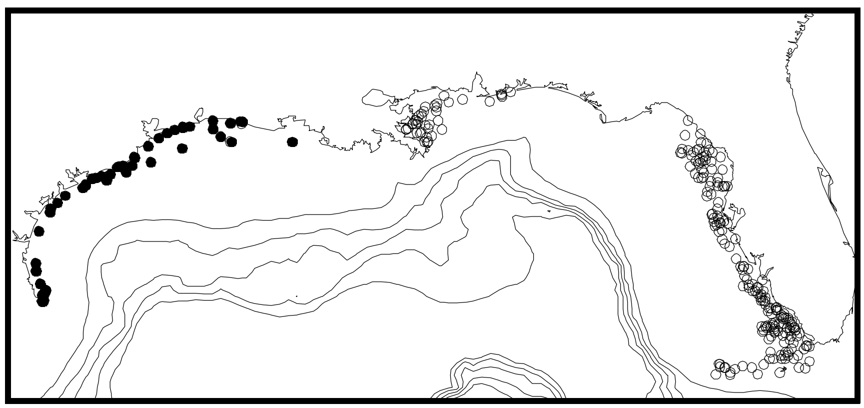

Figure 1. *Sightings of coastal bottlenose dolphins during GOMEX aerial surveys of the Gulf of Mexico in 1992-1994. Western Gulf of Mexico coastal bottlenose dolphin stock is shown with filled circles. Isobaths are in 183 m (100 fm) intervals.*

Some of this stock may co-occur with the resident bay, sound, and estuarine stocks, and breeding may occur among these stocks. For instance, two bottlenose dolphins previously seen in the South Padre Island area in Texas were seen in Matagorda Bay, 285 km north, in May 1992 and May 1993 (Lynn 1995). These sightings suggest that some bay stocks dolphins occasionally traverse the coastal stock area.

Portions of this stock may co-occur with the U.S. Gulf of Mexico outer continental shelf (OCS) stock. The seaward boundary for this stock corresponds to aerial survey strata (NMFS unpublished data) and thus, represents a management boundary rather than an ecological boundary. Anecdotal evidence suggests that both the coastal and OCS stocks consist of the shallow, warm water ecotype described by Hersh and Duffield (1990). Data are not currently available to determine genetically if the two stocks should be separated or, if so, where; and interbreeding may occur at the boundary interface.

POPULATION SIZE

Preliminary abundance estimates were derived using distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during aerial line-transect surveys in September-October 1992 (Blaylock and Hoggard 1994). Sampling transects extended orthogonally from shore out to approximately 9 km past the 18 m isobath. The 1992 coastal survey area extended from the U.S. -Mexican border to the Mississippi River mouth. Systematic transects were placed randomly with respect to bottlenose dolphin distribution and provided approximately 5% visual coverage of the survey area. Bottlenose dolphin abundance was estimated to be 3,499 dolphins (CV = 0.21) (Blaylock and Hoggard 1994).

Minimum Population Estimate

The minimum population estimate was based on the 1992 abundance estimate of 3,499 bottlenose dolphins (CV = 0.21) (Blaylock and Hoggard 1994). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 2,938 bottlenose dolphins.

Current Population Trend

Aerial surveys of this area conducted by NMFS in autumn 1983 resulted in an estimated bottlenose dolphin abundance of 4,718 (CV = 0.10). The data are not sufficient to conduct a statistical trend analysis, but the current population size estimate is significantly lower than the 1983 estimate (Student's t-test, $P < 0.001$) and suggests a decline in stock abundance.

This stock was subject to higher than usual mortality levels in 1990, 1992, and 1993-94, and the incidence of bottlenose dolphin strandings along the Texas coast in those years was significantly higher than the 1984-94 mean stranding rate (Southeast U.S. Marine Mammal Stranding Network unpublished data). Some of these mortalities may have been related to accumulation of anthropogenic hydrocarbon contaminants. A recent study indicated an inverse relationship between hydrocarbon contaminant levels and certain bacterial and viral antigen titers in bottlenose dolphins from Matagorda Bay, Texas (Reif et al., in review).

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 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 this stock is of unknown status, because of an undetermined level of fishery-related mortality, and because of the recent occurrence of three anomalous mortality events. PBR for this stock is 29 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of direct human-caused mortality in this stock is unknown. An annual mean of 13 (CV = 0.46) bottlenose dolphins stranded on the Texas coast during the period 1988-1993, showing signs of fishery interactions such as net entanglement, mutilation, gunshot wounds, etc. (Southeast U.S. Marine Mammal Stranding Network unpublished data). This was 10.3% of the total bottlenose dolphin strandings reported for this area. There were 283 reported bottlenose dolphin strandings in Texas (1994), of these 7 (2%) showed signs of human interaction. Three had evidence of fishery entanglement, one of which was found in a shrimp trawl, three were mutilated and one was shot. In 1995 the total number of reported bottlenose dolphins in Texas for 1995 was 110 and 3 (3%) were human interactions. One was found in a shrimp trawl. The total bottlenose dolphin strandings from January through August 31, 1996 was 175 and 1 (0.5%) had evidence of human interaction (entanglement).

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a bay, sound or estuarine stock; however, the proportion of the stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Annual fishing effort for the shrimp trawl fishery in the western Gulf of Mexico coastal stock area during 1988-1993 averaged approximately 0.35 million hours of tows (CV = 0.16) (NMFS unpublished data). This fishery was monitored by NMFS observers in 1992 and 1993, but less than 1% of the fishing effort was observed (NMFS unpublished data). There have been no reports of incidental mortality or injury in the western Gulf of Mexico coastal bottlenose dolphin stock associated with the shrimp trawl fishery in this area.

The menhaden purse seine fishery targets the Gulf menhaden, *Brevoortia patronus*, in Gulf of Mexico coastal waters approximately 3-18 m in depth (NMFS 1991). Seventy-five menhaden vessels operate within 1.6 km of shore from Apalachicola, Florida to Freeport, Texas, from April-October. Lethal takes of bottlenose dolphins reported by the menhaden fishery during the period 1982-1988 ranged between 0-4 dolphins annually (NMFS unpublished data).

Gillnets are not used in Texas, and gillnets over 46 m^3 in area will not be allowed in Florida past July 1995, but fixed and runaround gillnets are currently in use in Louisiana, Mississippi, and Alabama. These fisheries, for the most part, operate year around. They are state-controlled and licensed, and vary widely in intensity and target species. No marine mammal mortalities associated with gillnet fisheries have been reported in these states, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury.

The fishery for blue crabs operates in estuarine areas throughout the Gulf coast employing traps attached to a buoy with rope. Bottlenose dolphins have been reported stranded in Mississippi with polypropylene rope around their flukes indicating the possibility of entanglement with crab pot lines (NMFS 1991); however, this fishery has not been monitored by observers.

Two bottlenose dolphins were entangled and died in a scientific research net fishery for sea turtles in Sabine Pass in 1993 (A. Landry, Texas A&M University, report to Texas Marine Mammal Stranding Network, August 1993). The nets used in this Endangered Species Act (ESA) permitted research activity were two 4.9 m deep x 91.5 m in length stationary entanglement nets adjacent to each other. They were fished in shallow water (0.9-2.5 m depth), monitored continuously throughout the day, and removed at night.

Other Mortality

The coast adjacent to the nearshore habitat occupied by this stock varies from agricultural to industrial and, in some places, such as Galveston Island, is dense in human population. Concentrations of chlorinated hydrocarbons and metals were relatively low in most of the bottlenose dolphins examined in conjunction with an anomalous mortality event in Texas bays in 1990; however, some had concentrations at levels of possible toxicological concern (Varanasi et al. 1992). Agricultural runoff following periods of high rainfall in 1992 was implicated in a high level of bottlenose dolphin mortalities in Matagorda Bay, which is adjacent to the western coastal stock area (NMFS unpublished data). A recent study of hydrocarbon contaminant levels was conducted in conjunction with a health assessment study of 35 live-captured bottlenose dolphins in Matagorda Bay which adjoins the coastal stock area. Alpha-HCB, p,p,DDE, and PCB concentrations were inversely related to the magnitude of the serum antibody titer to *Erysipelas* spp. and *Staphylococcus* spp. bacteria (Reif et al., in review.). A similar and more pronounced trend was seen in relationship to the pseudorabies virus; however, since pseudorabies virus is not known to infect bottlenose dolphins, the significance of this finding is not clear. Concentrations of contaminants were higher in dolphins having evidence of exposure to the cetacean morbillivirus. The reason for the difference in the relationship between antibody titers to bacteria and pseudorabies and antibody titers to cetacean morbillivirus is not understood.

STATUS OF STOCK

The status of this stock relative to OSP is unknown. A population trend analysis is not available due to insufficient information. This species is not listed as threatened or endangered under the ESA. The occurrence of three anomalous mortality events among bottlenose dolphins along the Texas coast since 1990 (NMFS unpublished data) is cause for concern and the available evidence suggests that bottlenose dolphin stocks in the northern and western portion of the U.S. Gulf of Mexico may have experienced a morbillivirus epidemic in 1993 (Lipscomb 1993); however, the effects of these events on stock abundance has yet to be determined. 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 the known level of fishery-related mortality or serious injury does not exceed PBR.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Northern Gulf of Mexico Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The northern Gulf of Mexico coastal bottlenose dolphin stock has been defined for management purposes as those bottlenose dolphins occupying the nearshore coastal waters in the U.S. Gulf of Mexico from the Mississippi River mouth to approximately 84° W longitude, from shore, barrier islands, or presumed bay boundaries to 9.3 km seaward of the 18.3 m isobath (Fig. 1). As a working hypothesis, it is assumed that the dolphins occupying habitats with dissimilar climactic, coastal, and oceanographic characteristics might be restricted in their movements between habitats and, thus, constitute separate stocks. The northern coastal stock area is characterized by a temperate climate, barrier islands, sand beaches, coastal marshes and marsh islands, and has a relatively high level of fresh water input from rivers and streams. It is bordered on the east by an extensive area of coastal marsh and marsh islands typical of Florida's Apalachee Bay. The western coastal area is characterized by an arid to temperate climate, sand beaches, and low fresh water input. The eastern coastal stock area is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches, marsh and mangrove islands, and has an intermediate level of freshwater input.

The definition of this stock may be changed and it may be incorporated with other Gulf of Mexico stocks when more data become available. Seasonal changes in bottlenose dolphin abundance in Mississippi Sound (NMFS unpublished data) suggests that there is interchange with at least that portion of the Gulf of Mexico bay and sound stocks; however, its extent and significance is not presently known. Portions of this stock may co-occur with the U.S. Gulf of Mexico outer continental shelf (OCS) stock. The seaward boundary for this stock corresponds to aerial survey strata (NMFS unpublished data) and thus, represents a management boundary rather than an ecological boundary. Anecdotal evidence suggests that both the coastal and OCS stocks consist of the shallow, warm water ecotype described by Hersh and Duffield (1990). Data are not currently available to determine genetically if the stocks should be separated or, if so, where; and interbreeding may occur at the boundary interface.

Figure 1. *Sightings of coastal bottlenose dolphins during GOMEX aerial surveys of the Gulf of Mexico in 1992-1994. Northern Gulf of Mexico coastal bottlenose dolphin stock is shown with filled circles. Isobaths are in 183 m (100 fm) intervals.*

POPULATION SIZE

Preliminary estimates of abundance were derived using distance sampling analysis (Buckland et al.1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during aerial line-transect surveys in September-October 1993 (Blaylock and Hoggard 1994). Systematic sampling transects, placed randomly with respect to the bottlenose dolphin distribution, extended orthogonally from shore out to approximately 9 km past the 18 m isobath. The area surveyed extended from the Mississippi River mouth to approximately 84° W Longitude, and approximately 5% of the total area was visually searched. Bottlenose dolphin abundance was estimated to be 4,191 dolphins with coefficient of variation (CV) = 0.21 (Blaylock and Hoggard 1994).

Minimum Population Estimate

The minimum population estimate was based on the 1993 abundance estimate of 4,191 dolphins (CV = 0.21) (Blaylock and Hoggard 1994). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 3,518 bottlenose dolphins.

Current Population Trend

Aerial surveys of this area conducted partly in autumn 1983 and partly in autumn 1985, by NMFS resulted in an estimated bottlenose dolphin abundance of 1,319 (CV = 0.10). The data are not sufficient to conduct a statistical trend analysis, but the current population size estimate is significantly higher than the 1983-85 estimate (Student's t-test, P < 0.005).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates 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 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 this stock is of unknown status, because the stock apparently sustains some unknown level of fishery-related mortality, and because of the unknown effects of the 1993 mortality event. PBR for this stock is 35 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of direct human-caused mortality in this stock is unknown. An annual average of ten bottlenose dolphins (CV = 0.41) stranded on the coast of Louisiana, Mississippi, or Alabama during the period 1988-1993, showing signs of fishery interactions such as net entanglement, mutilation, gunshot wounds, etc. (Southeast U.S. Marine Mammal Stranding Network unpublished data). This was 8.2% of the total bottlenose dolphin strandings reported for this area. In 1994, the Stranding Network reported a total of 92 bottlenose dolphins in Mississippi, Louisiana and Alabama, four (4%) were reported as showing signs of human interaction. One was a boat strike, one entangled in fishing gear and 2 had gun shot wounds. There were 78 strandings reported in 1995 in the northern Gulf and 10 (12%) had evidence of human interaction; 6 were entanglements (2 were found wrapped in a square gillnet), two mutilations and 2 had gunshot wounds. A total of 120 bottlenose dolphin strandings was reported from January through August 31, 1996, and four (3%) of these were reported as human interactions (2 net entanglements, 1 boat strike and one mutilation).

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a bay, sound or estuarine stock; however, the proportion of the stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Annual fishing effort for the shrimp trawl fishery in the northern Gulf of Mexico coastal stock area during 1988-1993 averaged approximately 2.17 million hours of tows (CV = 0.13) (NMFS unpublished data). This fishery was monitored by NMFS observers in 1992 and 1993, but less than 1% of the fishing effort was observed (NMFS unpublished data). There have been no reports of incidental mortality or injury in the northern Gulf of Mexico coastal bottlenose dolphin stock associated with the shrimp trawl fishery in this area.

The menhaden purse seine fishery targets the Gulf menhaden, *Brevoortia patronus*, in Gulf of Mexico coastal waters approximately 3-18 m in depth (NMFS 1991). Seventy-five menhaden vessels operate within 1.6 km of shore from Apalachicola, Florida to Freeport, Texas, from April-October. Lethal takes of bottlenose dolphins reported by the menhaden fishery during the period 1982-1988 ranged between 0-4 dolphins annually (NMFS unpublished data).

Other clupeid purse seiners opportunistically target Spanish sardine, thread herring, ladyfish, cigarfish, and blue runners. Single boat purse seiners, fishing for sardines and herrings, operate in coastal waters between the Mississippi River delta and Pascagoula, Mississippi and in the Florida panhandle between Pensacola and Apalachicola. It is estimated that ten vessels participate in this fishery between May-October. There are no estimates of dolphin mortality associated with this fishery.

Gillnets are not used in Texas, and gillnets over 46 m^3 in area will not be allowed in Florida past July 1995, but fixed and runaround gillnets are currently in use in Louisiana, Mississippi, and Alabama. These fisheries, for the most part, operate year around. They are state-controlled and licensed, and vary widely in intensity and target species. No marine mammal mortalities associated with gillnet fisheries have been reported in these states, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury.

The fishery for blue crabs operates in estuarine areas throughout the Gulf coast employing traps attached to a buoy with rope. Bottlenose dolphins have been reported stranded in Mississippi with polypropylene rope around their flukes indicating the possibility of entanglement with crab pot lines (NMFS 1991); however, this fishery has not been monitored by observers.

Other Mortality

The nearshore habitat occupied by this stock is adjacent to areas of high human population. Two stranded dolphins from the northern Gulf coastal area (one from Mississippi and one from Alabama) had the highest levels of DDT derivatives of any of the bottlenose dolphin liver samples analyzed in conjunction with the 1990 mortality investigation conducted by NMFS (Varanasi et al. 1992). The significance of these findings are unclear, but there is some evidence that increased exposure to anthropogenic compounds may reduce immune function in bottlenose dolphins. A recent study found the magnitude of the serum antibody titer to *Erysipelas* spp. and *Staphylococcus* spp. bacteria in bottlenose dolphins was inversely related to á-HCB, p,p,DDE, and PCB's concentrations (Reif et al., in review).

This stock was subject to a high incidence of mortality in 1993, which was suspected to have been the result of a morbillivirus epidemic. The effect of this mortality event on the stock cannot be determined, in part, because the mortality may have also affected the bay, sound and estuarine stock and the stock identity of the stranded animals could not be determined. The increase in mortalities began in the Florida panhandle area and moved westward during that period (NMFS unpublished data). Concentrations of contaminants were found to be higher in dolphins having evidence of exposure to the cetacean morbillivirus (Reif et al., in review). The reason for the relationship between cetacean morbillivirus antibody titers and high contaminant levels is not understood and the effect of the epidemic on this stock has not been determined.

STATUS OF STOCK

The status of this stock relative to OSP is not known and population trends cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. The total fishery-related mortality and serious injury for this stock is unknown, but considering the evidence from stranding data, it may not be less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because the known level of fishery-related mortality or serious injury does not exceed PBR.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Eastern Gulf of Mexico Coastal Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The eastern Gulf of Mexico coastal bottlenose dolphin stock has been defined for management purposes as the bottlenose dolphins occupying the area which extends from approximately 84º W Longitude to Key West, Florida, from shore, barrier islands, or presumed bay boundaries to 9.3 km seaward of the 18.3 m isobath (Fig. 1). As a working hypothesis, it is assumed that the dolphins occupying habitats with dissimilar climactic, coastal, and oceanographic characteristics might be restricted in their movements between habitats and, thus, constitute separate stocks. The eastern coastal stock area is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches, marsh and mangrove islands, and has an intermediate level of freshwater input. It is bordered on the north by an extensive area of coastal marsh and marsh islands typical of Florida's Apalachee Bay. The western coastal area is characterized by an arid to temperate climate, sand beaches, and low fresh water input. The northern coastal stock area is characterized by a temperate climate, barrier islands, sand beaches, coastal marshes and marsh islands, and has a relatively high level of fresh water input from rivers and streams.

Figure 1. *Sightings of coastal bottlenose dolphins during GOMEX aerial surveys of the Gulf of Mexico in 1992-1994. Eastern Gulf of Mexico coastal bottlenose dolphin stock is shown with filled circles. Isobaths are in 183 m (100 fm) intervals.*

Portions of this stock may co-occur with the U.S. Gulf of Mexico outer continental shelf (OCS) stock. The seaward boundary for this stock corresponds to aerial survey strata (NMFS unpublished data) and thus, represents a management boundary rather than an ecological boundary. Anecdotal evidence suggests that both the coastal and OCS stocks consist of the shallow, warm water ecotype described by Hersh and Duffield (1990). Data are not currently available to determine genetically if the two stocks should be separated or, if so, where; and interbreeding may occur at the boundary interface.

POPULATION SIZE

Preliminary estimates of abundance were derived using distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during aerial line-transect surveys conducted during autumn 1994 (NMFS unpublished data). Systematic sampling transects, placed randomly with respect to the bottlenose dolphin distribution, extended orthogonally from shore out to approximately 9 km past the 18 m isobath. Approximately 5% of the total survey area was visually searched. Bottlenose dolphin abundance was estimated to be 9,912 dolphins with coefficient of variation (CV) = 0.12.

Minimum Population Estimate

The minimum population estimate was based on the 1994 abundance estimate of 9,912 (CV = 0.12) (NMFS unpublished data). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 8,963 bottlenose dolphins.

Current Population Trend

Aerial surveys of this area conducted by NMFS in autumn 1985, resulted in an estimated bottlenose dolphin abundance of 4,711 (CV = 0.05). The data are not sufficient to conduct a statistical trend analysis, but the current population size estimate is significantly higher than the 1985 estimate (Student's t-test, $P < 0.0005$).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. The maximum net productivity rate was assumed to be 0.04. 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 this stock is of unknown status. PBR for this stock is 90 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of direct human-caused mortality in this stock is unknown. An annual mean of eight bottlenose dolphins (CV = 0.41) stranded on the Florida Gulf coast during the period 1988-1993, showing signs of fishery interactions such as net entanglement, mutilation, gunshot wounds, etc. (Southeast U.S. Marine Mammal Stranding Network unpublished data). This was 8.9% of the total bottlenose dolphin strandings reported for this area. Morgan and Patton (1990) reported that 12.9% of 116 cetaceans examined by Mote Marine Laboratory's marine mammal stranding response program on the west coast of Florida between 1984 and 1990 exhibited evidence of human-caused mortality or serious injury. The stranding networks reported a total of 62 bottlenose dolphin strandings in 1994 with only one reported human interaction. Eighty-three strandings were reported in 1995 and 2 had evidence of human interactions. One was found entangled in a gillnet, and one was a boat strike. The network reported 111 bottlenose dolphins from January through August 31, 1996. Three showed signs of human interaction (one entanglement-gillnet, one boat strike and one mutilation).

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a bay, sound or estuarine stock; however, the proportion of the stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Annual fishing effort for the shrimp trawl fishery in the eastern Gulf of Mexico coastal stock area during 1988-1993 averaged approximately 0.102 million hours of tows (CV = 0.30) (NMFS unpublished data). This fishery was monitored by NMFS observers in 1992 and 1993, but less than 1% of the fishing effort was observed (NMFS unpublished data). There was one report in 1992 of an incidental mortality in the eastern Gulf of Mexico coastal bottlenose dolphin stock which was associated with the shrimp trawl fishery in this area.

Gillnets are not used in Texas, and gillnets over 46 m^3 in area will not be allowed in Florida past July 1995, but fixed and runaround gillnets are currently in use in Louisiana, Mississippi, and Alabama. These fisheries, for the most part, operate year around. They are state-controlled and licensed, and vary widely in intensity and target species. No marine mammal mortalities associated with gillnet fisheries have been reported in these states, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury. A coastal gillnet fishery for menhaden was reported to have taken one bottlenose dolphin in 1991 (NMFS unpublished data). There are no effort data available for this fishery.

The menhaden purse seine fishery targets the Gulf menhaden, *Brevoortia patronus*, in Gulf of Mexico coastal waters approximately 3-18 m in depth (NMFS 1991). Seventy-five menhaden vessels operate within 1.6 km of shore from Apalachicola, Florida to Freeport, Texas, from April-October. Lethal takes of bottlenose dolphins reported by the menhaden fishery during the period 1982-1988 ranged between 0-4 dolphins annually (NMFS unpublished data).

Other clupeid purse seiners opportunistically target Spanish sardine, thread herring, ladyfish, cigarfish, and blue runners. There are no effort data available for this fishery and there are no estimates of dolphin mortality associated with this fishery.

A fishery for blue crabs operates in estuarine areas throughout the Gulf coast employing traps attached to a buoy with rope. Bottlenose dolphins have been reported stranded in other coastal locations in the Gulf of Mexico with polypropylene rope around their flukes indicating the possibility of entanglement with crab pot lines (NMFS 1991); however, this fishery has not been monitored by observers.

Other Mortality

The nearshore habitat occupied by this stock is adjacent to areas of high human population and in some areas of Florida, such as the Tampa Bay area, is highly industrialized. PCB concentrations in three stranded dolphins sampled from this stock ranged from 16-46 μg/g wet weight. Concentrations of á-HCB, p,p,DDE, and PCB's were inversely related to the magnitude of the serum antibody titer to *Erysipelas* spp. and *Staphylococcus* spp. bacteria in a study of bottlenose dolphins in Texas (Reif et al., in review). A similar and more pronounced trend was seen in relationship to the pseudorabies virus; however, since pseudorabies virus is not known to infect bottlenose dolphins, the significance of this finding is not clear. Concentrations of contaminants were higher in dolphins having evidence of exposure to the cetacean morbillivirus. The reason for the difference in the relationship between antibody titers to bacteria and pseudorabies and antibody titers to cetacean morbillivirus is not understood.

STATUS OF STOCK

The status of this stock relative to OSP is not known and population trends cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because the known level of fishery-related mortality or serious injury does not exceed PBR.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus*): Gulf of Mexico Bay, Sound, and Estuarine Stocks

STOCK DEFINITION AND GEOGRAPHIC RANGE

Studies relying on identification of individual dolphins (Scott et al. 1990; Wells 1986a) suggest that bottlenose dolphins inhabiting many of the bays, sounds, and other estuaries adjacent to the Gulf of Mexico form discrete communities. Although breeding may occur between adjacent communities, the geographic nature of these areas suggests that each community exists as a functioning unit of its ecosystem and, under the Marine Mammal Protection Act, must be maintained as such. Therefore, each of those areas forming a contiguous, enclosed or semi-enclosed body of water is considered to contain a distinct bottlenose dolphin stock and will be reported as such within this report. However, because there are insufficient data currently available with which to evaluate fisheries within each area, a separate stock assessment report will not be prepared for each local stock at this time.

Mark-recapture studies using photo-identification of individual dolphins in the vicinity of Sarasota and Tampa Bays in Florida showed that individual dolphins remained in a given area year around (Scott et al. 1990). Wells (1986a) described three distinct dolphin "communities" in the area in and around Sarasota Bay. One community was formed by dolphins residing in the Gulf of Mexico coastal waters, another consisted of the dolphins in the deep water areas of Passage Key Inlet and Tampa Bay (adjacent to Sarasota Bay), and a third community resided in the shallow waters of Sarasota Bay. Electrophoretic isozyme analysis showed significant differences between dolphins of the shallow water Sarasota community and the Tampa Bay community, and from dolphins from Charlotte Harbor, to the south; however, there was a high degree of genetic heterozygosity indicating that the Sarasota community was not genetically isolated (Duffield and Wells 1986). Wells (1986b) suggested that the Sarasota community is likely one of a number of communities which comprise a population, the limits of which are unknown. He suggested that the continuous distribution of bottlenose dolphins around the Gulf of Mexico coast theoretically allows genetic exchange between adjacent communities; however, he also noted that the females of the highly-structured Sarasota community form a stable, discrete, long-term breeding unit with strong geographical fidelity (Wells 1986b). Depletion of a bottlenose dolphin community within a restricted geographical area could have a deleterious effect on its ability to recover. Conservative management practice dictates that such a community be treated as a stock for managing interactions with fisheries.

Recent photo-identification and radio-tracking studies confirmed that some individuals remained in the same general areas within Matagorda Bay, Texas, throughout the year (Lynn 1995); thus, the situation there may be similar to that of the Florida west coast. Movement by resident bottlenose dolphins in Texas through passes linking bays with the Gulf of Mexico appears to be relatively limited (Shane 1977; Gruber 1981; McHugh 1989; Lynn 1995), but it apparently does occur and these stocks may not be reproductively isolated from the coastal stocks. Two bottlenose dolphins previously seen in the South Padre Island, Texas, coastal area were seen in Matagorda Bay, 285 km north, in May 1992 and May 1993 (Lynn 1995). Preliminary analyses of MtDNA using polymerase chain reaction procedures suggested that Matagorda Bay dolphins appear to be a localized population (NMFS unpublished data). Over 1,000 individual bottlenose dolphins have been identified in bay and coastal waters near the northeast end of Galveston Island, Texas (Bräger et al. 1994; Bräger 1992, 1993; Henningsen 1991), but most of these were sighted only once and approximately 200 individuals were reported to use the area over the long term (Bräger et al. 1994).

Much less is known about the movements of resident bottlenose dolphins in estuaries of the northern Gulf of Mexico. There are observed seasonal differences in bottlenose dolphin abundance in Mississippi Sound that suggest seasonal migration (NMFS unpublished data); however, the spatial migration patterns are not currently known. It appears probable that some exchange occurs between the Mississippi Sound stock and the coastal stock in this area. Additional information may result in the future combining of these stocks in this area.

POPULATION SIZE

Population size (Table I) for all of the stocks except Sarasota Bay, Florida, was estimated from preliminary analyses of line-transect data collected during aerial surveys conducted in September-October 1992 in Texas and Louisiana, in September-October 1993 in Louisiana, Mississippi, Alabama, and the Florida panhandle (Blaylock and Hoggard 1994), and aerial surveys of the west coast of Florida in September-November 1994 (NMFS unpublished data). Standard line transect perpendicular sighting distance analytical methods were used (Buckland et al. 1993) and the

Blocks	Gulf of Mexico Estuary	N_{BEST}	CV	N_{MIN}	PBR	Year	Reference
B51	Laguna Madre	80	1.57	31	0.3	1992	Blaylock and Hoggard 1994
B52	Nueces Bay, Corpus Christi Bay	58	0.61	36	0.4	"	"
B50	Compano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espirito Santo Bay	55	0.82	30	0.3	"	"
B54	Matagorda Bay, Tres Palacios Bay, Lavaca Bay	61	0.45	42	0.4	"	"
B55	West Bay	29	1.10	14	0.1	"	"
B56	Galveston Bay, East Bay, Trinity Bay	152	0.43	107	1.1	"	"
B57	Sabine Lake	0	—	0	0.0	"	"
B58	Calcasieu Lake	0	—	0	0.0	"	"
B59	Vermillion Bay, West Cote Blanche Bay, Atchafalaya Bay	0 [1]	—	0	0.0	"	"
B60	TerreBonne Bay, Timbalier Bay	100	0.53	66	0.7	1993	"
B61	Barataria Bay	219	0.55	142	1.4	"	"
B30	Mississippi River Delta	0 [1]	—	0	0.0	"	"
B02-05,29,31	Bay Boudreau, Mississippi Sound	1,401	0.13	1,256	13	"	"
B06	Mobile Bay, Bonsecour Bay	122	0.34	92	0.9	"	"
B07	Perdido Bay	0 [1]	—	0	0.0	"	"
B08	Pensacola Bay, East Bay	33	0.80	18	0.2	"	"
B09	Choctawhatchee Bay	242	0.31	188	1.9	"	"
B10	St. Andrew Bay	124	0.57	79	0.8	"	"
B11	St. Joseph Bay	0	—	0	0.0	"	"
B12-13	St. Vincent Sound, Apalachicola Bay, St. Georges Sound	387	0.34	293	2.9	"	"
B14-15	Apalachee Bay	491	0.39	358	3.6	"	"
B16	Waccasassa Bay, Withlacoochee Bay, Crystal Bay	100	0.85	54	0.5	1994	"
B17	St. John's Sound, Clearwater Harbor	37	1.06	18	0.2	"	"
B32-34	Tampa Bay	559	0.24	458	4.6	"	"
B20	Sarasota Bay	97	na [3]	97	1.0	1992	Wells 1992
B35	Little Sarasota Bay	2 [2]	0.24	2	0.0	1985	Scott et al. 1989
B21	Lemon Bay	0 [1]	—	0	0.0	1994	Blaylock and Hoggard 1994
B22-23	Pine Sound, Charlotte Harbor, Gasparilla Sound	209	0.38	153	1.5	"	"
B36	Caloosahatchee River	0 [1,2]	—	0	0.0	1985	Scott et al. 1989
B24	Estero Bay	104	0.67	62	0.6	1994	Blaylock and Hoggard 1994
B25	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	208	0.46	144	1.4	"	"
B27	Whitewater Bay	242	0.37	179	1.8	"	"
B28	Florida Keys (Bahia Honda Key to Key West)	29	1.00	14	0.1	"	"

Table I. *Bottlenose dolphin abundance (N_{BEST}), coefficient of variation (CV), minimum population estimate (N_{MIN}), and Potential Biological Removal (PBR) in U.S. Gulf of Mexico bays, sounds, and other estuaries. Blocks refer to aerial survey blocks illustrated in Fig. 1.*

Notes: [1]Bottlenose dolphins not sighted during earlier surveys (Scott et al. 1989). [2]Block not surveyed during surveys reported in Blaylock and Hoggard (1994). [3]No CV because N_{BEST} was a direct count of known individuals.

computer program DISTANCE (Laake et al. 1993). Stock size in Sarasota Bay, Florida, was obtained through direct count of known individuals (Wells 1992).

Minimum Population Estimate

The minimum population estimate (Table I) is the lower limit of the two-tailed 60% confidence interval of the log-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. Three anomalous mortality events have occurred among portions of this stock between 1990 and 1994; however, it is not possible to accurately partition the mortalities between the bay and coastal stocks, thus the impact of these mortality events on these stocks is not known.

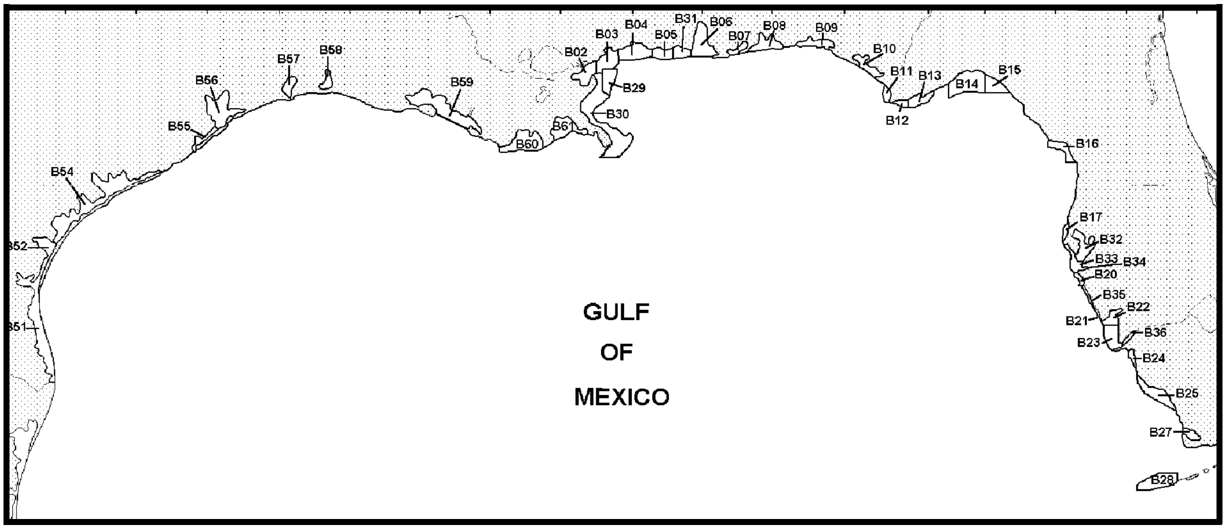

Figure 1. *U.S. Gulf of Mexico bays and sounds. Each of the alpha-numerically designated blocks corresponds to one of the NMFS Southeast Fisheries Science Center logistical aerial surveys areas listed in Table I. The bottlenose dolphins inhabiting each bay and sound are considered to comprise a unique stock for purposes of this assessment.*

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for these stocks. 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 I.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

An annual mean of 30 bottlenose dolphins with coefficient of variation (CV) = 0.21 stranded on the coast in the U.S. Gulf of Mexico during the period 1988-1993, showing signs of fishery interactions such as net entanglement, mutilation, gunshot wounds, etc. (Southeast U.S. Marine Mammal Stranding Network unpublished data). This represented 9.6% of the total bottlenose dolphin strandings reported for the entire U.S. Gulf of Mexico. Morgan and Patton (1990) reported that 12.9% of 116 cetacean carcasses examined by Mote Marine Laboratory's marine mammal stranding response program on the west coast of Florida between 1984 and 1990 exhibited evidence of human-caused mortality or serious injury.

There are a number of difficulties associated with the interpretation of stranding data. It is possible that some or all of the stranded dolphins may have been from a nearby coastal stock; however, the proportion of the stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Some of these stocks were the focus of a live-capture fishery for bottlenose dolphins which supplied dolphins to the U.S. Navy and to oceanaria for research and for public display for almost two decades (NMFS unpublished data). During the period between 1972-89, 490 bottlenose dolphins, an average of 29 dolphins annually, were removed from a few locations in the Gulf of Mexico, including the Florida Keys. Mississippi Sound sustained the highest level of removals and 202 dolphins were removed from this stock during this period, representing 41% of the total and an annual average of 12 dolphins (compared to a current PBR of 13). The annual average number of removals never exceeded the current PBR levels, but it may be biologically significant that 73% of the dolphins removed during 1982-88 were females. The impact of those removals on the stocks is unknown.

Fishery Information

Annual fishing effort for the shrimp trawl fishery in the U.S. Gulf of Mexico bays, sounds, and estuaries during 1988-1993 averaged approximately 2.20 million hours of tows (CV = 0.11) (NMFS unpublished data). There have been no reports of incidental mortality or injury in any of these stocks associated with the shrimp trawl fishery.

A fishery for blue crabs operates in estuarine areas throughout the Gulf of Mexico coast employing traps attached to a buoy with rope. Bottlenose dolphins have been reported stranded with polypropylene rope around their flukes (NMFS 1991; NMFS unpublished data) indicating the possibility of entanglement with crab pot lines; however, entanglement has not been reported by fishermen. This fishery has not been monitored by observers and there are no estimates of bottlenose dolphin mortality or serious injury for this fishery.

Gillnets are not used in Texas, and gillnets over 46 m^3 in area will not be allowed in Florida past July 1995, but fixed and runaround gillnets are currently in use in Louisiana, Mississippi, and Alabama. These fisheries, for the most part, operate year around. They are state-controlled and licensed, and vary widely in intensity and target species. No marine mammal mortalities associated with gillnet fisheries have been reported in these states, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury.

Other Mortality

The nearshore habitat occupied by many of these stocks is adjacent to areas of high human population and in some bays, such as Mobile Bay in Alabama and Galveston Bay in Texas, is highly industrialized. The area surrounding Galveston Bay, for example, has a coastal population of over 3 million people. More than 50% of all chemical products manufactured in the U.S. are produced there and 17% of the oil produced in the Gulf of Mexico is refined there (Henningsen and Würsig 1991). Many of the enclosed bays in Texas are surrounded by agricultural lands which receive periodic pesticide applications.

Concentrations of chlorinated hydrocarbons and metals were examined in conjunction with an anomalous mortality event of bottlenose dolphins in Texas bays in 1990, and were relatively low in most; however, some had concentrations at levels of possible toxicological concern (Varanasi et al. 1992). No studies to date have determined the amount, if any, of indirect human-induced mortality resulting from pollution or habitat degradation. A recent assessment of the health of 35 bottlenose dolphins from Matagorda Bay, Texas, however, associated high levels of chlorinated hydrocarbons with low health assessment scores (Reif et al., in review).

STATUS OF STOCK

The status of these stocks relative to OSP is unknown and this species is not listed as threatened or endangered under the Endangered Species Act. The occurrence of three anomalous mortality events among bottlenose dolphins along the U.S. Gulf of Mexico coast since 1990 (NMFS unpublished data) is cause for concern; however, the effects of the mortality events on stock abundance have not yet been determined. The available evidence suggests that bottlenose dolphin stocks in the northern and western coastal portion of the U.S. Gulf of Mexico may have experienced morbillivirus epidemic in 1993 (Lipscomb 1993; Lipscomb et al. 1994). Seven of 35 live-captured bottlenose dolphins (20%) from Matagorda Bay, Texas, in 1992, tested positive for previous exposure to cetacean morbillivirus (Reif et al., in review) and it is possible that other estuarine resident stocks have been exposed to the morbillivirus.

Low-level monitoring surveys in Mississippi Sound indicated a significantly lower average summer bottlenose dolphin abundance between 1985 and 1993 (NMFS unpublished data). The apparent decline in summer abundance of bottlenose dolphins in Mississippi Sound is evidence of a possible downward trend in abundance; however, there are insufficient data available with which to conduct a trend analysis. The relatively high number of bottlenose dolphin deaths which occurred during the recent mortality events suggests that some of these stocks may be stressed. Fishery-related mortality and serious injury for each of these stocks is not known, but considering the evidence from stranding data, the total fishery-related mortality and serious injury exceeds 10% of the total PBR and, therefore, is not insignificant and approaching zero mortality and serious injury rate. 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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July 1995

ATLANTIC SPOTTED DOLPHIN (*Stenella frontalis*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Atlantic spotted dolphin is endemic to the Atlantic Ocean in warm temperate to tropical waters (Perrin et al. 1987, 1994). Sightings of this species are concentrated along the continental shelf edge and also occur over the continental shelf in the northern Gulf of Mexico [Fritts et al. 1983; Mullin et al. 1991; Southeast Fisheries Science Center (SEFSC) unpublished data], but they have been reported as occurring around oceanic islands and far offshore in other areas (Perrin et al. 1994). The island and offshore animals may be a different stock than those occurring on the continental shelf (Perrin et al. 1994). Atlantic spotted dolphins were seen in all seasons during seasonal recent GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). Atlantic spotted dolphins were seen in 1992 during regional aerial surveys conducted in the autumn of 1992-1994 over the U.S. continental shelf [see Blaylock and Hoggard (1994) for a description of the areas surveyed in 1992-1993]. These surveys were designed to estimate abundance of bottlenose dolphins and spotted dolphin abundance was not estimated. It has been suggested that there may be a seasonal movement of this species onto the continental shelf in the spring, but data supporting this hypothesis are limited (Caldwell and Caldwell 1966; Fritts et al. 1983).

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of Atlantic spotted dolphins [coefficient of variation (CV) in parentheses] by survey year was zero in 1991, 4,527 in 1992 (0.65), 4,618 in 1993 (0.62), and 2,186 in 1994 (0.85) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of Atlantic spotted dolphins for all surveys combined was 3,213 (CV = 0.44) (Hansen et al. 1995). This is probably an underestimate and should be considered a partial stock estimate because the continental shelf areas were not generally covered by either the vessel or GulfCet aerial surveys.

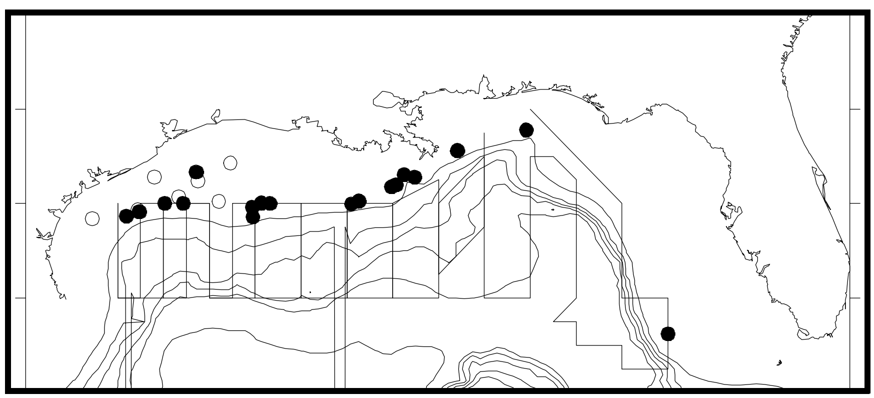

Figure 1. *Distribution of Atlantic spotted dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994 (filled circles) and during GOMEX regional aerial surveys during 1992-1994 (unfilled circles). The straight lines show transects during two ship surveys and are examples of typical ship survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated using the average abundance estimate of Atlantic spotted dolphins for all surveys combined which was 3,213 (CV = 0.44) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 2,255 Atlantic spotted dolphins.

Current Population Trend

No trend was identified in the annual abundance estimates. There were no sightings of this stock during 1991. The lack of sightings during 1991 may have been due to less sampling that year along the continental shelf edge where sightings of this species were concentrated. The difference in abundance estimates during 1992-1994 were not significant using the criteria of no overlap of log-normal 95 % confidence intervals.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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 (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. The PBR, based on the partial estimate, for this stock is 23 dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of Atlantic spotted dolphins in the northern Gulf of Mexico is unknown; however, interactions between spotted dolphins and fisheries have been observed in the northern Gulf of Mexico.

There were two documented strandings of Atlantic spotted dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Total estimated average annual fishing-related mortality and serious injury of spotted dolphins (both species) is 1.5 spotted dolphins annually (CV = 0.33).

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were two observed incidental takes and releases of spotted dolphins in the Gulf of Mexico during 1994, but no observed lethal takes of Atlantic spotted dolphins by this fishery in the Gulf of Mexico.

Estimates of fishery-related mortality and serious injury which occurred during 1992-1993 were based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take for the entire Atlantic longline swordfish/tuna fishery (which includes the Gulf of Mexico) (SEFSC, unpublished data). Takes observed throughout the range of this fishery were used because the species occurs generally throughout the area of the fishery, but observed takes were infrequent in any given region. Either spotted dolphin species may have been involved in the observed fishery-related mortality and serious injury incidents, but because of the difficulty of species identification by fishery observers, they cannot currently be separated. Estimated mortality and serious injury to spotted dolphins attributable to the longline fishery for the entire fishery (including waters outside of the Gulf of Mexico) for 1993 was 16 (CV = 0.19). Estimated fishery-related mortality and serious injury for the Gulf of Mexico, based on proportionality of fishing effort (number of sets) in 1993 was 4.4 spotted dolphins. Estimated average annual fishing-related mortality and serious injury of spotted dolphins attributable to this fishery during 1991-1993 was 1.5 annually (CV = 0.33).

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The estimated take by the longline fishery for 1994-1995 is an average of 7 animals per year, therefore observed fishery-related mortality and serious injury for spotted dolphins is greater than 10% of PBR and cannot be considered insignificant and approaching zero mortality and serious injury rate for this stock. The total level of human-caused mortality and serious injury is unknown, but it is believed to be low relative to PBR; therefore, this is not a strategic stock.

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PANTROPICAL SPOTTED DOLPHIN (*Stenella attenuata*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pantropical spotted dolphin is distributed worldwide in tropical and some sub-tropical oceans (Perrin et al. 1987; Perrin and Hohn 1994). Sightings of this species occurred over the deeper waters of the northern Gulf of Mexico, and rarely over the continental shelf or continental shelf edge [Mullin et al. 1991; Southeast Fisheries Science Center (SEFSC) unpublished data]. Pantropical spotted dolphins were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). Some of the Pacific populations have been divided into different geographic stocks based on morphological characteristics (Perrin et al. 1987; Perrin and Hohn 1994); however, there is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of pantropical spotted dolphins by survey year [coefficient of variation (CV) in parentheses] was 19,767 in 1991 (0.45), 15,280 in 1992 (0.36), 29,414 in 1993 (0.29), and 71,847 in 1994 (0.31) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of pantropical spotted dolphins for all surveys combined was 31,320 (CV = 0.20) (Hansen et al. 1995).

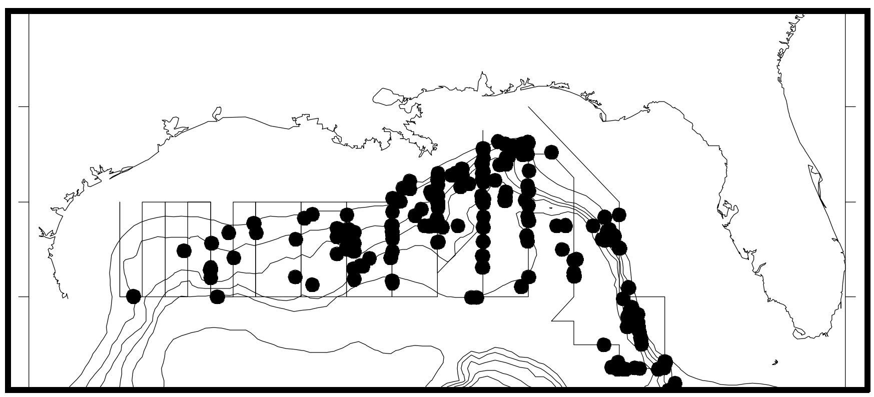

Figure 1. *Distribution of pantropical spotted dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance of pantropical spotted dolphins which was 31,320 (CV = 0.20) (Hansen et al. 1995).The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 26,510 pantropical spotted dolphins.

Current Population Trend

The 1994 abundance estimate was larger than the estimates for 1991-1993. The 1992 and 1994 estimates were significantly different using the criteria of no overlap of log-normal 95% confidence intervals, but differences within 1991-1993 estimates and differences between 1991, 1993, and 1994 were not significant. The observed differences in abundance estimates may have been caused by inter-annual variation in distribution patterns and spatial sampling, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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. The PBR for this stock is 265 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of pantropical spotted dolphins in the northern Gulf of Mexico is unknown; however, interactions between spotted dolphins and fisheries have been observed in the northern Gulf of Mexico.

There was one documented stranding of a pantropical spotted dolphin in the northern Gulf of Mexico during 1987-1994 which was classified as likely caused by fishery interactions. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Total estimated average annual fishing-related mortality and serious injury of spotted dolphins (both species) is 1.5 spotted dolphins annually (CV = 0.33).

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were two observed incidental takes and releases of spotted dolphins in the Gulf of Mexico during 1994, but no observed lethal takes of Atlantic spotted dolphins by this fishery in the Gulf of Mexico.

Estimates of fishery-related mortality and serious injury were based on a generalized linear model (Poisson error assumption) fit to the available observed incidental take for the entire Atlantic longline swordfish/tuna fishery (which includes the Gulf of Mexico) (SEFSC, unpublished data). Takes observed throughout the range of this fishery were used because the species occurs generally throughout the area of the fishery, but observed takes were infrequent in any given region. Either spotted dolphin species may have been involved in the observed fishery-related mortality and serious injury incidents, but because of the difficulty of species identification by fishery observers, they cannot currently be separated. Estimated mortality and serious injury to spotted dolphins attributable to the longline fishery for the entire fishery (including waters outside of the Gulf of Mexico) for 1993 was 16 (CV = 0.19). Estimated fishery-related mortality and serious injury for the Gulf of Mexico, based on proportionality of fishing effort (number of sets) in 1993 was 4.4 spotted dolphins. Estimated average annual fishing-related mortality and serious injury of spotted dolphins attributable to this fishery during 1991-1993 was 1.5 annually (CV = 0.33).

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. Observed fishery-related mortality and serious injury for spotted dolphins is less than 10% of PBR and can be considered insignificant and approaching zero mortality and serious injury rate for this stock. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

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July 1995

STRIPED DOLPHIN (*Stenella coeruleoalba*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The striped dolphin is distributed worldwide in tropical to warm temperate oceanic waters (Leatherwood and Reeves 1983; Perrin et al. 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Mullin et al. 1991; Southeast Fisheries Science Center (SEFSC) unpublished data]. Striped dolphins were seen in fall, winter, and spring during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of striped dolphins by survey year [coefficient of variation (CV) in parentheses] was 3,483 in 1991 (0.76), 2,574 in 1992 (0.52), 4,160 in 1993 (0.63), and 8,147 in 1994 (0.60) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of striped dolphins for all surveys combined was 4,858 (CV = 0.44) (Hansen et al. 1995).

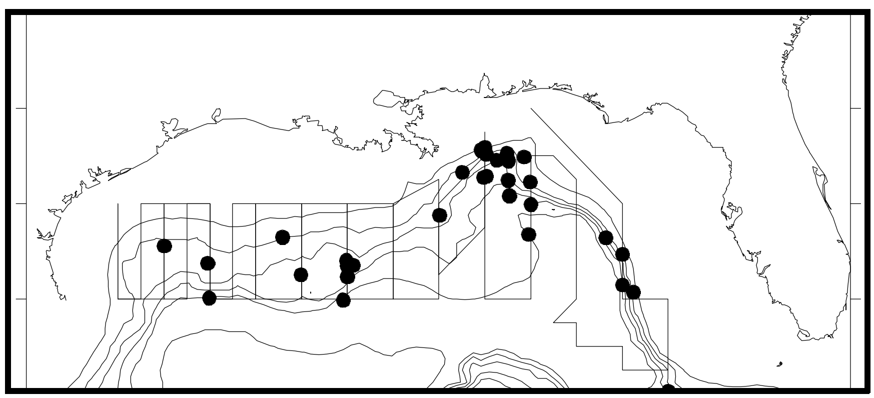

Figure 1. *Distribution of striped dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 4,858 striped dolphins (CV = 0.44) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 3,409 striped dolphins.

Current Population Trend

The abundance estimates for 1991-1993 were less than the 1994 estimate. The abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by small sample sizes; only 29 observations of herds of striped dolphins were used in the distance sampling analysis. The differences in the estimates may also have been caused by inter-annual variation in distribution patterns and spatial sampling, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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 this stock is 34 striped dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of striped dolphins in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with striped dolphins in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of striped dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to striped dolphins by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. Total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

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July 1995

SPINNER DOLPHIN (*Stenella longirostris*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The spinner dolphin is distributed worldwide in tropical to warm temperate waters in the world's oceans (Leatherwood and Reeves 1983; Perrin and Gilpatrick 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Southeast Fisheries Science Center (SEFSC) unpublished data]. Spinner dolphins were seen in winter, spring and summer during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). Different geographic stocks have been identified in the Pacific based on morphological characteristics (Perrin and Gilpatrick 1994); however, there is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of spinner dolphins by survey year [coefficient of variation (CV) in parentheses] was zero in 1991, 2,593 in 1992 (0.63), 2,336 in 1993 (0.62), and 15,995 in 1994 (0.67) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of spinner dolphins for all surveys combined was 6,316 (CV = 0.43) (Hansen et al. 1995).

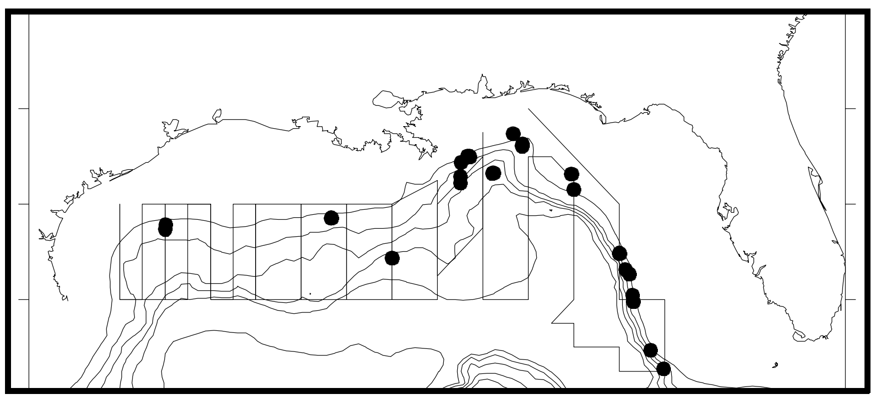

Figure 1. *Distribution of spinner dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 6,316 spinner dolphins (CV = 0.43) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 4,465 spinner dolphins.

Current Population Trend

The abundance estimates for 1992 and 1993 were approximately the same and the 1994 estimate was considerably larger; however, the estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by less sampling effort during 1991 (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates 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 this stock is 45 spinner dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of spinner dolphins in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with spinner dolphins in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of spinner dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the dolphins which die or are seriously injured in fishery interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of spinner dolphins by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

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July 1995

ROUGH-TOOTHED DOLPHIN (*Steno bredanensis*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The rough-toothed dolphin is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983; Miyazaki and Perrin 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Southeast Fisheries Science Center (SEFSC) unpublished data]. Rough-toothed dolphins were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of rough-toothed dolphins by survey year [coefficient of variation (CV) in parentheses] was 545 in 1991 (1.15), 758 in 1992 (0.58), 1,192 in 1993 (0.48), and 527 in 1994 (0.86) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of rough-toothed dolphins for all surveys combined was 852 (CV = 0.31) (Hansen et al. 1995).

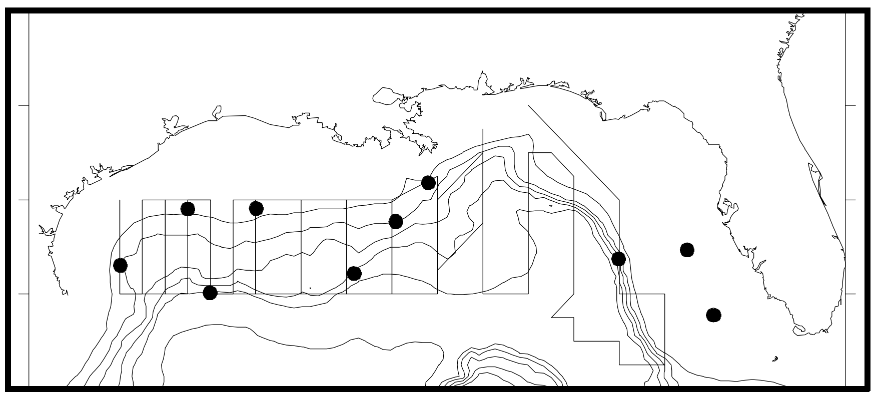

Figure 1. *Distribution of rough-toothed dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 852 rough-toothed dolphins (CV = 0.31) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 660 rough-toothed dolphins.

Current Population Trend

The 1993 abundance estimate was greater than the 1991, 1993, and 1994 estimates; however, the abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by small sample sizes (Hansen et al. 1995) or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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 this stock is 6.6 rough-toothed dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of rough-toothed dolphins in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with rough-toothed dolphins in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of rough-toothed dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of rough-toothed dolphins by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. Total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

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CLYMENE DOLPHIN (*Stenella clymene*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Clymene dolphin is endemic to tropical and sub-tropical waters of the Atlantic (Leatherwood and Reeves 1983; Perrin and Mead 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf (Mullin et al. 1994). Clymene dolphins were seen in the winter, spring and summer during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of Clymene dolphins by survey year [coefficient of variation (CV) in parentheses] was 1,936 in 1991 (0.69), 3,390 in 1992 (0.48), 6,486 in 1993 (0.46), and 12,255 in 1994 (0.62) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of Clymene dolphins for all surveys combined was 5,571 (CV = 0.37) (Hansen et al. 1995).

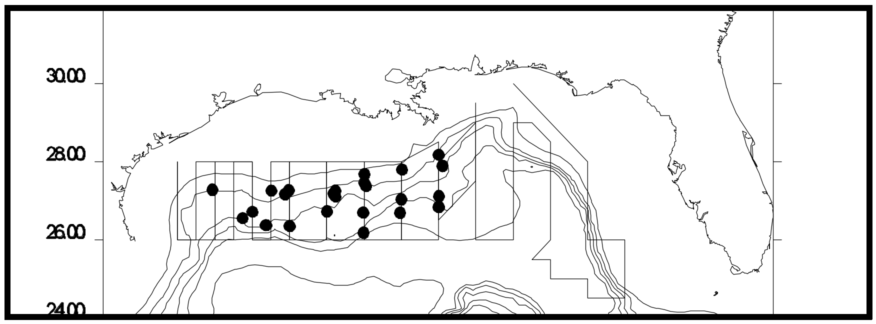

Figure 1. *Distribution of clymene dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 5,571 Clymene dolphins (CV = 0.37) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 4,120 Clymene dolphins.

Current Population Trend

The abundance estimates showed an increasing trend during 1991-1994; however, the estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by small sample sizes (Hansen et al. 1995) or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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 this stock is 41 Clymene dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of Clymene dolphins in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with Clymene dolphins in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of Clymene dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to Clymene dolphins by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

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FRASER'S DOLPHIN (*Lagenodelphis hosei*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fraser's dolphin is distributed worldwide in tropical waters (Perrin et al. 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf (Leatherwood et al. 1993). Fraser's dolphins have been observed recently in the northern Gulf of Mexico during the spring, summer, and fall (Leatherwood et al. 1993), and also were seen in the winter during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of Fraser's dolphins by survey year [coefficient of variation (CV) in parentheses] was zero in 1991, 443 in 1992 (0.92), and zero in 1993 and 1994 (Hansen et al. 1995). Survey effort-weighted estimated average abundance of Fraser's dolphins for all vessel surveys combined was 127 (CV = 0.90) (Hansen et al. 1995).

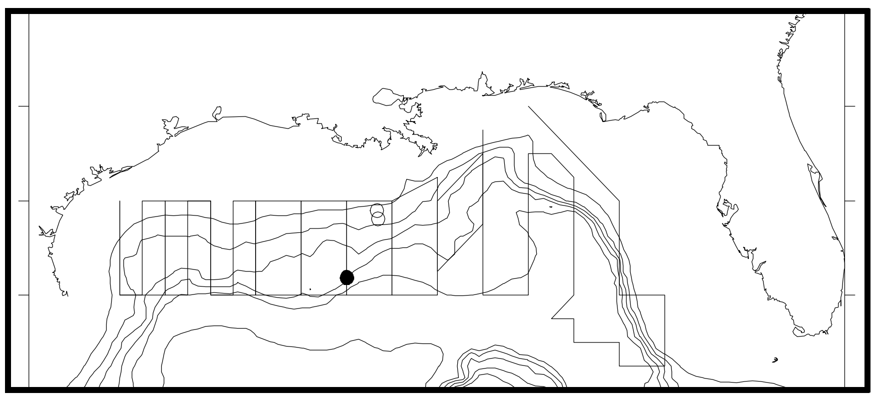

Figure 1. *Distribution of Fraser's dolphin sightings during NOAA Ship Oregon II surveys during 1991-1994 (filled circle) and during GulfCet seasonal aerial surveys (unfilled circles). The straight lines show transects during two ship surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 127 Fraser's dolphins (CV = 0.90) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 66 Fraser's dolphins.

Current Population Trend

No trend was identified in the annual abundance estimates. There were no observations of Fraser's dolphins during 1991 and 1993 vessel surveys, and the 1992 estimate is based on only one observation (Hansen et al. 1995); however, five other sightings of Fraser's dolphins were documented in the northern Gulf of Mexico during other surveys in 1992, 1993 and 1994 (Leatherwood et al. 1993, SEFSC unpublished data). The apparent differences in abundance estimates may have been caused by low sampling intensity relative to population size (Hansen et al. 1995) or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known 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 this stock is 0.7 Fraser’s dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of Fraser's dolphins in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with Fraser’s dolphins in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of Fraser's dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Available information indicates there likely is little, if any, fisheries interaction with Fraser's dolphins in the northern Gulf of Mexico.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of Fraser’s dolphins by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore this is not a strategic stock.

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July 1995

KILLER WHALE (*Orcinus orca*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The killer whale is distributed worldwide from tropical to polar regions (Leatherwood and Reeves 1983). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Southeast Fisheries Science Center (SEFSC) unpublished data]. Killer whales were seen only in the summer during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996) and in the late spring during vessel surveys (SEFSC unpublished data). Different stocks have been identified in the northeastern Pacific based on morphological, behavioral, and genetic characteristics (Bigg et al. 1990; Hoelzel 1991). There is no information on stock differentiation for the Atlantic population, although an analysis of vocalizations of killer whales from Iceland and Norway indicated that stocks from these areas may represent different stocks (Moore et al. 1988).

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated killer whale abundance by survey year [coefficient of variation (CV) in parentheses] was zero in 1991, 138 in 1992 (0.96), 641 in 1993 (0.50), and 193 in 1994 (1.12) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of killer whales for all surveys combined was 277 (CV = 0.42) (Hansen et al. 1995).

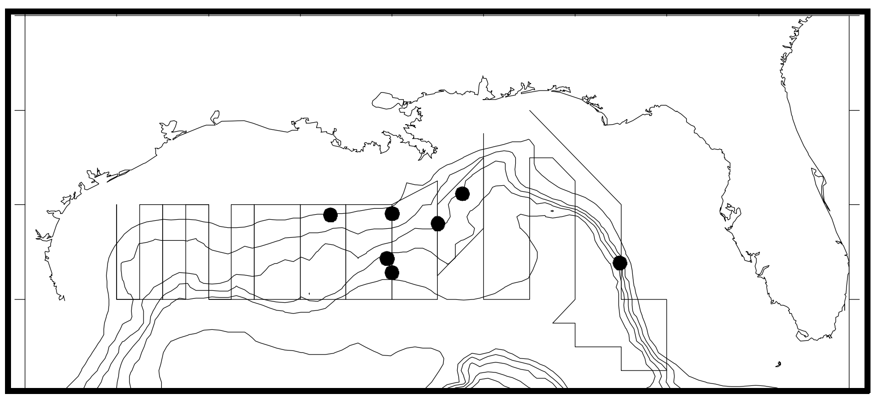

Figure 1. *Distribution of killer whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 277 killer whales (CV = 0.42) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 197 killer whales.

Current Population Trend

The abundance estimates were highest during 1993; however, there were no observations of this species during 1991, and the 1992-1994 estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, and by low sampling intensity relative to population size (Hansen et al. 1995) or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size. Preliminary analysis of existing photo-identification data shows that some individual whales have been seen during more than one survey (SEFSC unpublished data).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates 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 this stock is 2.0 killer whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of killer whales in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with killer whales in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of killer whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of killer whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

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FALSE KILLER WHALE (*Pseudorca crassidens*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The false killer whale is distributed worldwide throughout warm temperate and tropical oceans (Leatherwood and Reeves 1983). Sightings of this species in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Southeast Fisheries Science Center (SEFSC) unpublished data]. False killer whales were seen only in the summer during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996) and in the late spring during vessel surveys (NMFS unpublished data). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of false killer whales by survey year [coefficient of variation (CV) in parentheses] was 661 in 1991 (0.88), 196 in 1992 (1.00), 77 in 1993 (1.08), and 744 in 1994 (1.14) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of false killer whales for all surveys combined was 381 (CV = 0.62) (Hansen et al. 1995).

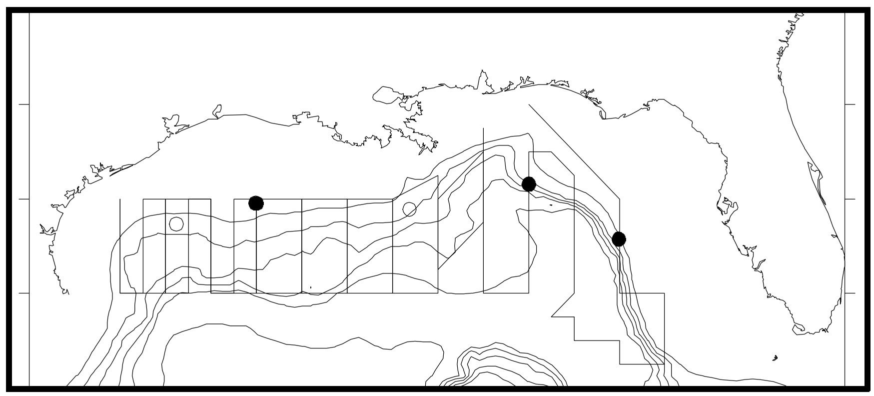

Figure 1. *Distribution of false killer whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994 (filled circles) and during GulfCet seasonal aerial surveys (filled circles). The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 381 false killer whales (CV = 0.62) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 236 false killer whales.

Current Population Trend

No trend was identified in the annual abundance estimates, and the differences in the abundance estimates were not significant using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known 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 this stock is 2.4 false killer whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of false killer whales in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with false killer whales in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of false killer whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of false killer whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

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PYGMY KILLER WHALE (*Feresa attenuata*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy killer whale is distributed worldwide in tropical and subtropical waters (Ross and Leatherwood 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf [Southeast Fisheries Science Center (SEFSC) unpublished data]. Pygmy killer whales and melon-headed whales (*Peponocephala electra*) are difficult to distinguish and sightings of either species are often categorized as pygmy killer/melon-headed whales. Sightings of this category were documented in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of pygmy killer whales by survey year [coefficient of variation (CV) in parentheses] was 2,347 in (0.81), 356 in 1992 (0.73), 153 in 1993 (1.13), and zero in 1994 (Hansen et al. 1995). Survey effort-weighted estimated average abundance of pygmy killer whales for all surveys combined was 518 (CV = 0.81) (Hansen et al. 1995).

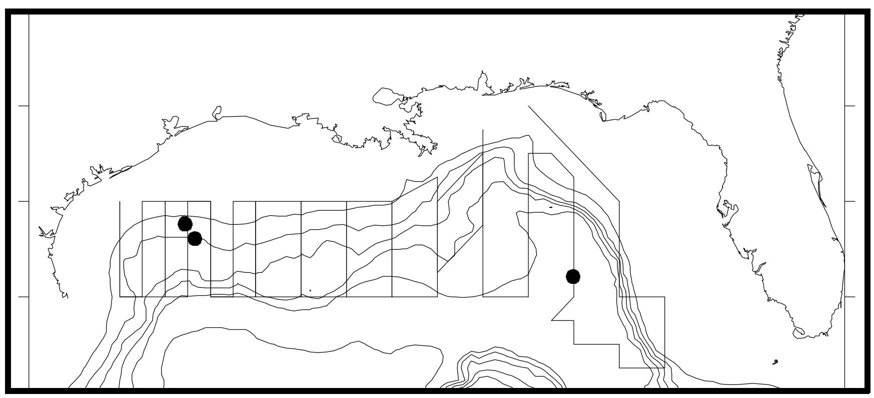

Figure 1. *Distribution of pygmy killer whale sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 518 pygmy killer whales (CV = 0.81) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 285 pygmy killer whales.

Current Population Trend

A declining trend was identified in the annual abundance estimates; however, the 1991-1993 abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. There were no observations of this species during the 1994 survey. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known 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 this stock is 2.8 pygmy killer whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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

There were no documented strandings of pygmy killer whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of pygmy killer whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of human-caused mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

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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 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily along the continental shelf edge and over the deeper waters off the continental shelf (Mullin et al. 1991; Southeast Fisheries Science Center, SEFSC, unpublished data). Dwarf sperm whales and pygmy sperm whales (*Kogia breviceps*) are difficult to distinguish and sightings of either species are often categorized as *Kogia* spp. Sightings of this category were documented in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). There is no information on stock differentiation.

POPULATION SIZE

Estimates of abundance of *Kogia* spp. were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of *Kogia* spp. by survey year [coefficient of variation (CV) in parentheses] was 109 in 1991 (0.68), 1,010 in 1992 (0.40), 580 in 1993 (0.45), and 162 in 1994 (0.61) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of *Kogia* spp. for all surveys combined was 547 (CV = 0.28) (Hansen et al. 1995). Estimates of dwarf sperm whale abundance cannot be provided due to uncertainty of species identification at sea.

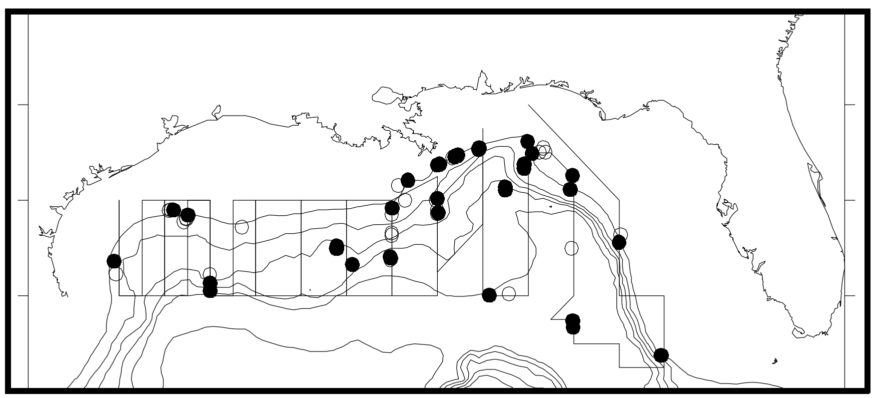

Figure 1. *Distribution of all Kogia sightings (unfilled circles) and sightings identified as dwarf sperm whales (filled circles) during NOAA Ship Oregon II marine mammal surveys in 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

A minimum population estimate was not calculated because of uncertainty of species identification at sea.

Current Population Trend

A declining trend is evident in the annual abundance estimates since 1992; however, the 1991, 1993 and 1994 abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, and by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known 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 1987-1994 which were classified as likely caused by fishery interactions, but there have been stranding investigation reports of dwarf sperm whales which may have died as a result of other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of dwarf sperm whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

Other Mortality

A total of at least nine dwarf sperm whale strandings were documented in the northern Gulf of Mexico from 1987-present; one of these animals had a plastic bag in its stomach.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. 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. Upon the advice of the Atlantic Scientific Review Group this stock has been designated a strategic stock because PBR cannot be determined and there is an unknown amount of possible human-caused mortality from the ingestion of marine debris such as plastic bags.

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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 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily along the continental shelf edge and over the deeper waters off the continental shelf (Mullin et al. 1991; Southeast Fisheries Science Center, SEFSC, unpublished data). Pygmy sperm whales and dwarf sperm whales (*Kogia simus*) are difficult to distinguish and sightings of either species are often categorized as *Kogia* spp. Sightings of this category were documented in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). There is no information on stock differentiation.

POPULATION SIZE

Estimates of abundance of *Kogia* spp. were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of *Kogia* spp. by survey year [coefficient of variation (CV) in parentheses] was 109 in 1991 (0.68), 1,010 in 1992 (0.40), 580 in 1993 (0.45), and 162 in 1994 (0.61) (Hansen et al. 1995). Survey effort-weighted estimated abundance of *Kogia* spp. for all surveys combined was 547 (CV = 0.28) (Hansen et al. 1995). Estimates of pygmy sperm whale abundance cannot be provided due to uncertainty of species identification at sea.

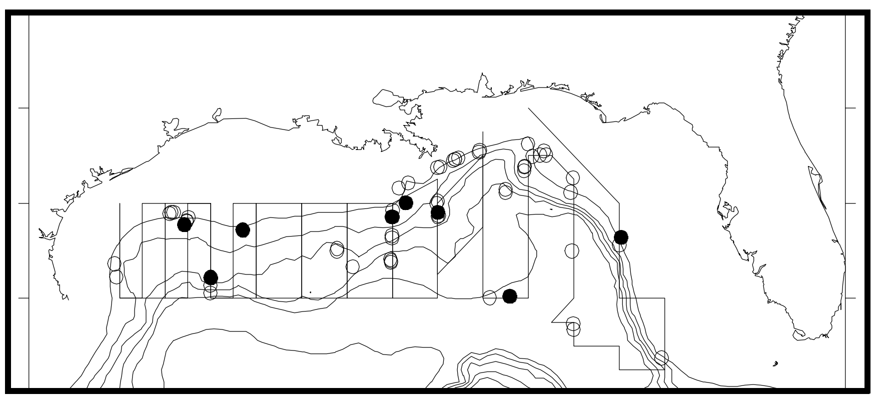

Figure 1. *Distribution of all Kogia sightings (unfilled circles) and sightings identified as pygmy sperm whales (filled circles) during NOAA Ship Oregon II marine mammal surveys in 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

A minimum population estimate could not be calculated because of uncertainty of species identification at sea.

Current Population Trend

A declining trend is evident in the annual abundance estimates since 1992; however, the 1991, 1993 and 1994 abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, and by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known 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 1987-1994 which have been classified as likely caused by fishery interactions, but there have been stranding investigation reports of pygmy sperm whales which may have died as a result of other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury of pygmy sperm whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

Other Mortality

At least 13 pygmy sperm whale strandings were documented in the northern Gulf of Mexico from 1987-present; one of these animals had a plastic bag in its stomach and another stranded apparently due to injuries inflicted by impact, possibly with a vessel.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. 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. Upon the advice of the Atlantic Scientific Review Group this stock has been designated a strategic stock because PBR cannot be determined and there is an unknown amount of possible human-caused mortality from the ingestion of marine debris such as plastic bags and possibly from collision with vessels.

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July 1995

MELON-HEADED WHALE (*Peponocephala electra*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The melon-headed whale appears to be distributed worldwide in tropical to sub-tropical waters (Perryman et al. 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf (Mullin et al. 1994). Melon-headed whales and pygmy killer whales (*Feresa attenuata*) are difficult to distinguish and sightings of either species are often categorized as pygmy killer/melon-headed whales. Sightings of this category were documented in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Seasonal aerial survey data were insufficient for estimating abundance. Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig.1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of melon-headed whales by survey year [coefficient of variation (CV) in parentheses] was zero in 1991, 3,174 in 1992 (0.54), 827 in 1993 (0.70) and 10,586 in 1994 (0.48) (Hansen et al. 1995). The survey effort-weighted estimated average abundance of melon-headed whales for all surveys combined was 3,965 (CV = 0.39) (Hansen et al. 1995).

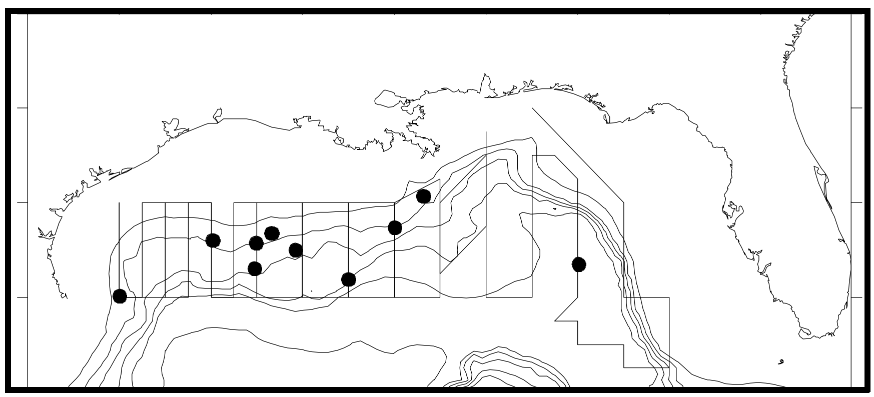

Figure 1. *Distribution of melon-headed whale sightings during NOAA Ship Oregon II marine mammal surveys in 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) depth intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 3,965 (CV = 0.39) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 2,888 melon-headed whales.

Current Population Trend

No trend was identified in the annual abundance estimates; however, the 1994 estimate was more than ten times larger than the 1993 estimate and the difference was significant using the criteria of no overlap of log-normal 95% confidence intervals. No melon-headed whales were sighted during 1991, and the differences between the 1992 and 1993 estimates and between the 1993 and 1994 estimates were not significant. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991, and by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known 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 this stock is 29 melon-headed whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell et al. 1976); however, the level of past or current, direct, human-caused mortality of melon-headed whales in the northern Gulf of Mexico is unknown. Available information indicates there likely is little, if any, fisheries interaction with melon-headed whales in the northern Gulf of Mexico. There have been no logbook reports of fishery-related mortality or serious injury and no fishery-related mortality or serious injury has been observed.

There were no documented strandings of melon-headed whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. There were no reports of mortality or serious injury to melon-headed whales by this fishery.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown. This species is not listed under the Endangered Species Act. There are insufficient data to determine population trends. The total known fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered insignificant and approaching zero mortality and serious injury rate. The total level of fishery-related mortality and serious injury is unknown, but it is believed to be insignificant relative to PBR; therefore, this is not a strategic stock.

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RISSO'S DOLPHIN (*Grampus griseus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphin is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983). Sightings of these animals in the northern Gulf of Mexico occur primarily along the continental shelf and continental slope (Mullin et al. 1991; Southeast Fisheries Science Center, SEFSC, unpublished data). Risso's dolphin were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996) and in the late spring during vessel surveys (SEFSC, unpublished data). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Seasonal aerial survey data were insufficient for abundance estimation. Estimates of abundance were derived through the application of distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) to sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig.1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range and these data were not used for abundance estimation. Estimated abundance of Risso's dolphins by survey year [coefficient of variation (CV) in parentheses] was 667 in 1991 (0.95), 2,325 in 1992 (0.34), 1,408 in 1993 (0.41), and 6,332 in 1994 (0.45) (Hansen et al. 1995). Survey effort-weighted average abundance of Risso's dolphins estimated for all surveys combined was 2,749 (CV = 0.27) (Hansen et al. 1995).

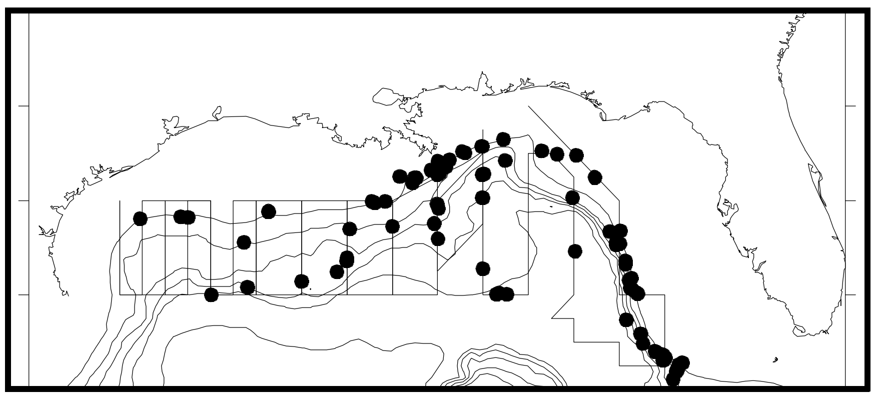

Figure 1. *Distribution of Risso's dolphin sightings during NOAA Ship Oregon II marine mammal surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 2,749 Risso's dolphins (CV = 0.27) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 2,199 Risso's dolphins.

Current Population Trend

No trend was identified in the annual abundance estimates. The 1994 abundance estimate was greater than the other annual estimates, but no annual estimates differed significantly using the criteria of no overlap of log-normal 95% confidence intervals. The apparent differences in abundance estimates may have been caused by lower sampling effort during 1991 (Hansen et al. 1995) or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates 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 this stock is 22 Risso's dolphins.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of Risso's dolphins in the northern Gulf of Mexico is unknown. This species has been taken in the U.S. longline swordfish/tuna fishery in the northern Gulf of Mexico and in the U.S. Atlantic (Lee et al. 1994). Estimated average annual fishery-related mortality and serious injury attributable to the longline swordfish/tuna fishery in the Gulf of Mexico during 1992-1993 was 19 Risso's dolphins annually (CV = 0.20).

There were no documented strandings of Risso' dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Interactions between the U.S. longline swordfish/tuna fishery and Risso' dolphins have been documented in the northern Gulf of Mexico (Lee et al. 1994). Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery has been monitored with about 5% observer coverage, in terms of trips observed, since 1992. One Risso's dolphin was observed taken and released alive during 1992; the extent of injury to the animal was unknown (SEFSC, unpublished data). One lethal take of a Risso's dolphin by the fishery was observed in the Gulf of Mexico during 1993 (SEFSC, unpublished data). Annual fishery-related mortality and incidental injury was estimated using a generalized linear model (Poisson error assumption) fit to the available observed incidental take data for the entire fishery and partitioned on the fishery effort (number of sets) in the Gulf of Mexico. Estimated total mortality and serious injury to Risso's dolphins (CV in parentheses) in the Gulf of Mexico in 1992 was 24 (0.19), and in 1993 it was 13 (0.20). Estimated average annual fishery-related mortality and serious injury attributable to the longline swordfish/tuna fishery in the Gulf of Mexico during 1992-1993 was 19 Risso's dolphins annually (CV = 0.20).

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown. This species is not listed under the Endangered Species Act and there are insufficient data to determine population trends. The total estimated fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because fishery-related mortality and serious injury does not exceed PBR; however, fishery-related mortality and serious injury is very close to PBR and requires close monitoring.

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SHORT-FINNED PILOT WHALE (*Globicephala macrorhynchus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The short-finned pilot whale is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983). Sightings of these animals in the northern Gulf of Mexico occur primarily along the continental shelf and continental slope [Mullin et al. 1991; Southeast Fisheries Science Center (SEFSC) unpublished data]. Short-finned pilot whales were seen in all seasons during recent seasonal GulfCet aerial surveys of the northern Gulf of Mexico during 1993-1995 (Hansen *et al*. 1996). There is no information on stock differentiation for the Atlantic population.

POPULATION SIZE

Abundance was estimated using distance sampling analysis (Buckland et al. 1993) and the computer program DISTANCE (Laake et al. 1993) with sighting data collected during 1991-1994 spring-summer, visual sampling, line-transect vessel surveys of the northern Gulf of Mexico (Hansen et al. 1995) (Fig. 1), which includes data collected as part of the GulfCet program (Hansen *et al*. 1996). These surveys were conducted throughout the area from approximately the 200 m isobath along the U.S. coast to the seaward extent of the U.S. Exclusive Economic Zone. The seasonal GulfCet aerial surveys included only a small portion of the stock range, so those data were not used for abundance estimation. Estimated abundance of short-finned pilot whales by survey year [coefficient of variation (CV) in parentheses] was zero in 1991, 909 in 1992 (0.62), 103 in 1993 (1.20), and 240 in 1994 (1.03) (Hansen et al. 1995). Survey effort-weighted estimated average abundance of short-finned pilot whales for all surveys combined was 353 (CV = 0.89) (Hansen et al. 1995).

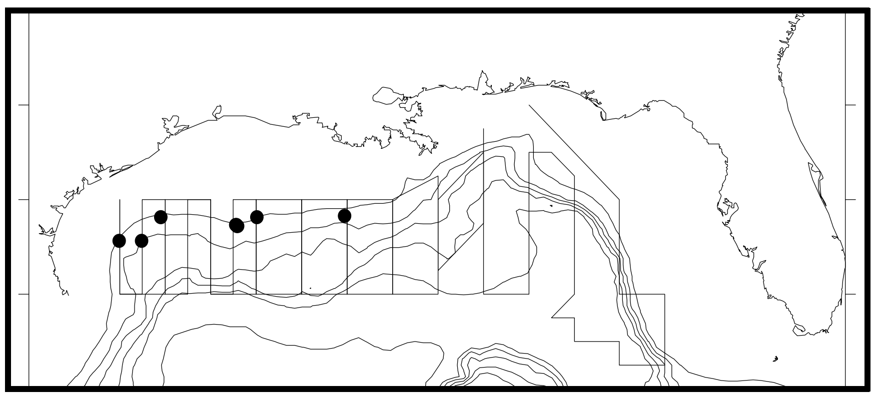

Figure 1. *Distribution of short-finned pilot whale sightings during NOAA Ship Oregon II surveys during 1991-1994. The straight lines show transects during two surveys and are examples of typical survey transects. Isobaths are in 183 m (100 fm) intervals.*

Minimum Population Estimate

The minimum population size was estimated from the average estimated abundance which was 353 pilot whales (CV = 0.89) (Hansen et al. 1995). The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-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 is 186 pilot whales.

Current Population Trend

The annual abundance estimates were not significantly different using the criteria of no overlap of log-normal 95% confidence intervals. The variation in abundance estimates that was observed may have been caused by lower sampling effort during 1991, by low sampling intensity relative to population size (Hansen et al. 1995), or by inter-annual variation in distribution patterns or spatial sampling patterns, rather than changes in population size.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for this stock. 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 this stock is 1.9 short-finned pilot whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The level of past or current, direct, human-caused mortality of short-finned pilot whales in the northern Gulf of Mexico is unknown. This species has been taken in the U.S. longline swordfish/tuna fishery in U.S. Atlantic waters (Lee et al. 1994) and there is a logbook report of a fishery-related mortality or serious injury in the northern Gulf of Mexico (NMFS unpublished data); however, fishery-related mortality or serious injury has not been observed. Total known fishery-related mortality or serious injury is estimated to be 0.3 short-finned pilot whales per year based upon the logbook report.

There were no documented strandings of short-finned pilot whales in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions or other human-related causes. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured may wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interaction.

Fisheries Information

Pelagic swordfish, tunas, and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. Interactions between the U.S. longline swordfish/tuna fishery and short-finned pilot whales have been reported in the northern Gulf of Mexico (SEFSC, unpublished logbook data), but have not been observed by NMFS fishery observers. Total longline effort for the Gulf of Mexico pelagic fishery, including OCS edge, continental slope, and Mexican territorial waters, based on mandatory logbook reporting, was 4,400 sets in 1991, 4,850 sets in 1992, and 3,260 sets in 1993 (Cramer 1994). This fishery was been monitored with about 5% observer coverage in both the Atlantic Ocean and the Gulf of Mexico, in terms of trips observed, in 1992-1993. There was one logbook report of a fishery-related injury of a pilot whale in the northern Gulf of Mexico in 1991, but no fishery interactions were observed during 1992-1993. Total known fishery-related mortality or serious injury is estimated to be 0.3 short-finned pilot whales per year based upon the logbook report.

Pair trawl fishing gear has the potential to capture marine mammals, but there have been no reports of mortality or serious injury to marine mammals in the Gulf of Mexico. This fishery has not been observed by NMFS observers, and there are no other data available as to the extent of this fishery in the Gulf of Mexico. It is assumed that it is very limited in scope and duration.

STATUS OF STOCK

The status of this stock relative to OSP is unknown and there are insufficient data to determine population trends. This species is not listed under the Endangered Species Act. The total known fishery-related mortality and serious injury for this stock is greater than 10% of the calculated PBR and, therefore, cannot be considered insignificant and approaching zero mortality and serious injury rate. The total level of estimated fishery-related mortality and serious injury is unknown, but because there is a record of a fishery-related mortality or serious injury and because of the extremely low estimated stock size, this is a strategic stock.

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APPENDIX I
Summary of marine mammal stock assessment reports for stocks of marine mammals that occupy Atlantic and Gulf of Mexico waters under U.S. jurisdiction and are under NMFS jurisdiction.

Species	Stock Area	Region	NMFS Center	Nmin	Rmax	Fr	PBR	Total Annual Mort.	Annual Fish. Mort.	Strategic Status
Harbor seal	Western North Atlantic	ATL	NEC	28,810	0.12	1.0	1,729	476	476	N
Gray seal	Northwest North Atlantic	ATL	NEC	2,035	0.12	1.0	122	4.5	4.5	N
Harp seal	Northwest North Atlantic	ATL	NEC	N/A	N/A	N/A	N/A	0.00	0.00	N
Hooded seal	Northwest North Atlantic	ATL	NEC	N/A	N/A	N/A	N/A	0.00	0.00	N
Harbor porpoise	Gulf of Maine/Bay of Fundy	ATL	NEC	48,289	0.04	0.5	483	1,834	1,834	Y
Risso's dolphin	Western North Atlantic	ATL	NEC	11,140	0.04	0.5	111	68	68	N
Atlantic white-sided dolphin	Western North Atlantic	ATL	NEC	19,196	0.04	0.5	192	181	181	N
White-beaked dolphin	Western North Atlantic	ATL	NEC	N/A	0.04	N/A	N/A	0.00	0.00	N
Common dolphin	Western North Atlantic	ATL	NEC	15,470	0.04	0.5	155	234	234	Y
Atlantic spotted dolphin	Western North Atlantic	ATL	NEC	1,617[1]	0.04	0.5	16	22	22[1]	Y
Pantropical spotted dolphin	Western North Atlantic	ATL	NEC	1,617[1]	0.04	0.5	16	22[1]	22[1]	Y
Striped dolphin	Western North Atlantic	ATL	NEC	18,220	0.04	0.45	164	47	47	N
Spinner dolphin	Western North Atlantic	ATL	NEC	N/A	N/A	N/A	N/A	1.0	1.0	N
Bottlenose dolphin	Western North Atlantic, offshore	ATL	NEC	8,794[2]	0.04	0.5	88	82	82	N
Bottlenose dolphin	Western North Atlantic, coastal	ATL	SEC	2,482	0.04	0.5	25	29	29	Y

Species	Stock Area	Region	NMFS Center	Nmin	Rmax	Fr	PBR	Total Annual Mort.	Annual Fish. Mort.	Strategic Status
Dwarf sperm whale	Western North Atlantic	ATL	NEC	N/A	0.04	N/A	N/A	0.2	0.2	Y
Pygmy sperm whale	Western North Atlantic	ATL	NEC	N/A	0.04	N/A	N/A	N/A	N/A	Y
Killer whale	Western North Atlantic	ATL	NEC	N/A	0.04	N/A	N/A	0.00	0.00	N
Pygmy killer whale	Western North Atlantic	ATL	SEC	6	0.04	0.5	0.1	0.00	0.00	N
Northern bottlenose whale	Western North Atlantic	ATL	NEC	N/A	0.04	N/A	N/A	0.00	0.00	N
Cuvier's beaked whale	Western North Atlantic	ATL	NEC	895[3]	0.04	0.5	8.9	9.7	9.7[4]	Y
Mesoplodont beaked whale	Western North Atlantic	ATL	NEC	895[3]	0.04	0.5	8.9	9.7	9.7[4]	Y
Pilot whale, long-finned (Globicephala spp.)	Western North Atlantic	ATL	NEC	4,968[5]	0.04	0.5	50	42	42[6]	N[7]
Pilot whale, short-finned	Western North Atlantic	ATL	NEC	457	0.04	0.5	3.7	42	42[6]	Y
Sperm whale	Western North Atlantic	ATL	NEC	1,617	0.04	0.1	3.2	0.2	0.2	Y
North Atlantic right whale	Western North Atlantic	ATL	NEC	295	0.025	0.1	0.4	2.5	1.1[8]	Y
Humpback whale	Western North Atlantic	ATL	NEC	4,848	0.04	0.1	9.7	0.7	4.1[9]	Y
Fin whale	Western North Atlantic	ATL	NEC	1,704	0.04	0.1	3.4	0.0	0.00	Y
Sei whale	Western North Atlantic	ATL	NEC	N/A	0.04	0.1	N/A	0.00	0.00	Y
Minke whale	Canadian east coast	ATL	NEC	2,053	0.04	0.5	21	2.5	2.5	N
Blue whale	Western North Atlantic	ATL	NEC	N/A	0.04	0.1	N/A	0.00	0.00	Y
Bottlenose dolphin	Gulf of Mexico, outer continental shelf	ATL	SEC	43,233	0.04	0.5	432	2.8	2.8[10]	N
Bottlenose dolphin	Gulf of Mexico, continental shelf edge and slope	ATL	SEC	4,530	0.04	0.5	45	2.8	2.8[10,11]	N

Species	Stock Area	Region	NMFS Center	Nmin	Rmax	Fr	PBR	Total Annual Mort.	Annual Fish. Mort.	Strategic Status
Bottlenose dolphin	Western Gulf of Mexico coastal	ATL	SEC	2,938	0.04	0.5	29	13	13[11,12]	N
Bottlenose dolphin	Northern Gulf of Mexico coastal	ATL	SEC	3,518	0.04	0.5	35	10	10[11]	N
Bottlenose dolphin	Eastern Gulf of Mexico coastal	ATL	SEC	8,963	0.04	0.5	90	8	8[11]	N
Bottlenose dolphin	Gulf of Mexico bay, sound, and estuarine[13]	ATL	SEC	3,933	0.04	0.5	39.7	30	30[11]	Y
Atlantic spotted dolphin	Northern Gulf of Mexico	ATL	SEC	2,255	0.04	0.5	23	1.5[1]	1.5[1]	N
Pantropical spotted dolphin	Northern Gulf of Mexico	ATL	SEC	26,510	0.04	0.5	265	1.5[1]	1.5[1]	N
Striped dolphin	Northern Gulf of Mexico	ATL	SEC	3,409	0.04	0.5	34	0.00	0.00	N
Spinner dolphin	Northern Gulf of Mexico	ATL	SEC	4,465	0.04	0.5	45	0.00	0.00	N
Rough-toothed dolphin	Northern Gulf of Mexico	ATL	SEC	660	0.04	0.5	6.6	0.00	0.00	N
Clymene dolphin	Northern Gulf of Mexico	ATL	SEC	4,120	0.04	0.5	41	0.00	0.00	N
Fraser's dolphin	Northern Gulf of Mexico	ATL	SEC	66	0.04	0.5	0.7	0.00	0.00	N
Killer whale	Northern Gulf of Mexico	ATL	SEC	197	0.04	0.5	2.0	0.00	0.00	N
False killer whale	Northern Gulf of Mexico	ATL	SEC	236	0.04	0.5	2.4	0.00	0.00	N
Pygmy killer whale	Northern Gulf of Mexico	ATL	NEC	285	0.04	0.05	2.8	0.00	0.00	N
Dwarf sperm whale	Northern Gulf of Mexico	ATL	SEC	N/A	0.04	N/A	N/A	0.00	0.00	Y
Pygmy sperm whale	Northern Gulf of Mexico	ATL	SEC	N/A	0.04	N/A	N/A	0.00	0.00	Y
Melon-headed whale	Northern Gulf of Mexico	ATL	SEC	2,888	0.04	0.5	29	0.00	0.00	N
Risso's dolphin	Northern Gulf of Mexico	ATL	SEC	2,199	0.04	0.5	22	19	19	N
Cuvier's beaked whale	Northern Gulf of Mexico	ATL	SEC	20	0.04	0.5	0.2	0.00	0.00	N

Species	Stock Area	Region	NMFS Center	Nmin	Rmax	Fr	PBR	Total Annual Mort.	Annual Fish. Mort.	Strategic Status
Blainville's beaked whale	Northern Gulf of Mexico	ATL	SEC	N/A	N/A	N/A	N/A	0.00	0.00	N
Gervais' beaked whale	Northern Gulf of Mexico	ATL	SEC	N/A	N/A	N/A	N/A	0.00	0.00	N
Pilot whale, short-finned	Northern Gulf of Mexico	ATL	SEC	186	0.04	0.5	1.9	0.3	0.3	Y
Sperm whale	Northern Gulf of Mexico	ATL	SEC	411	0.04	0.1	0.8	0.00	0.00	Y
Bryde's whale	Northern Gulf of Mexico	ATL	SEC	17	0.04	0.5	0.2	0.00	0.00	N

1. This value includes either or both *Stenella frontalis* or *Stenella attenuata*.
2. Estimates may include sightings of the coastal form.
3. This estimate includes *Cuvier's* beaked whales and mesoplodont beaked whales.
4. 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.
5. This estimate includes both long-finned and short-finned pilot whales.
6. Mortality data are not separated by species; therefore, species-specific estimates are not available. The mortality estimate represents both long-finned and short-finned pilot whales.
7. Mortality estimates for the 1994-1995 pelagic longline fishery are not available; status may be revised when these are available.
8. This is the average mortality of right whales based on 5 years of observer data (0.4) and additional fishery impact records (0.7).
9. This is the average mortality of humpback whales based on 5 years of observer data (0.7) and additional fishery impact records (3.4).
10. This value may include either or both of the Gulf of Mexico, continental shelf edge and slope, and the outer continental shelf stock of bottlenose dolphins.
11. Low levels of bottlenose dolphin mortality (0.4 per year) incidental to commercial fisheries have been reported. It is unknown to which stock this mortality can be attributed.
12. Estimates derived from stranded animals with signs of fishery interactions, and these could be either coastal or estuary stocks.
13. This entry encompasses 33 stocks of bottlenose dolphins. All stocks are considered strategic; see the full report for information on individual stocks. The listed estimates for abundance, PBR, and mortality are sums across all bays, sounds, and estuaries.

APPENDIX II
Bycatch Estimation Methods

Marine mammals have been incidentally taken in the following commercial fisheries since 1989: 1) New England multispecies sink gillnet fishery; 2) the Pelagic Drift Gillnet; 3) the Pelagic Pair Trawl; 4) the North Atlantic Bottom Trawl fishery; and 5) the Longline fishery. Table 1 identifies the species that have been incidentally killed by commercial fishery and the time period used to estimate total mortality. Bycatch data have been collected by the Northeast Fisheries Science Center's (NEFSC) Sea Sampling Program. Observers are placed on commercial vessels to collect information on the fishing activity, operations, fish discards and marine mammal interactions. These data are used to estimate take rates of marine mammals.

Calculation of total bycatch for each fishery, require estimates of total fishing effort, and the average take rate of marine mammals per unit of effort. Two data sources have been used to estimate total effort for these four fisheries: 1) the NEFSC weighout (WO) database and 2) the mandatory self-reported fisheries information system for large pelagic fisheries maintained at the Southeast Fisheries Science Center (SEFSC).

Components of the estimation process are: 1) choosing a stratification scheme; 2) calculating a point estimate and; 3) estimating its variance and confidence interval. First, the data are examined for temporal and spatial patterns in both the movement of the marine mammal species and the commercial fishery. Observed patterns may be used to stratify the data. Take estimates are then calculated for each stratum and combined over strata to estimate the total annual take. Standard bootstrap techniques are used to calculate the variance and 95% confidence intervals.

Methods to estimate the total fishery specific marine mammal take are briefly described below. The estimation process within a fishery and year are identical. For example, if three marine mammal species are taken within one year and one fishery, the method of estimating the total take for each species is the same.

New England Multispecies Sink Gillnet Fishery

The US bottom-tending sink gillnet fishery extends from Maine to North Carolina. Sink gillnet gear as fished in the NW Atlantic, consists of nets with 8-10 inch monofilament mesh suspended between a buoyed head rope and a weighted ground line. A sink gillnet vessel fishes four to seven strings per trip on average. One string typically consists of five to twelve nets strung together, in which the standard net length averages three hundred feet and height averages eleven feet. Gear is set in the water to soak for 24 to 72 hours. The gear is then hauled and reset. Target species include pollock, cod, flatfish, monkfish, and dogfish. Marine mammals may become entangled in the gear and suffocate while the gear is in the water.

Marine mammal take rates and total effort were estimated from NEFSC's Sea Sampling and WO data. Total effort for this analysis is measured by total landings of all fish species in terms of 'live' pounds of fish caught (NEFSC 1992; Bisack and Dinardo, 1992), before processing. A haul was chosen as the unit of effort and is defined as the retrieval of a string of nets. This eliminates uncertainty caused by the varying number of hauls within a trip. There is no direct measure of hauls in the WO data. Total hauls are estimated by dividing the average catch per haul in the sea sampling data, into corresponding total landings from the weightout. Therefore, the total marine mammal bycatch is equal to the product of the estimated take per haul from the Sea Sampling data and the estimated total hauls, as shown below.

$$Total\ Take = \frac{Total\ Observed\ Take}{Total\ Observed\ Hauls} * Total\ Estimated\ Hauls$$

$$Total\ Estimated\ Hauls = \frac{Total\ WO\ Landings}{Average\ Catch\ per\ Haul}$$

$$Average\ Catch\ per\ Haul = \frac{Total\ Observed\ Catch}{Total\ Observed\ Hauls}$$

The temporal stratification to make harbor porpoise bycatch estimate in 1995, for example, was three seasons: winter (January to May), summer (June to August) , and fall (September to December). The spatial stratification consisted of six groups of ports covering: 1) northern Maine; 2) southern Maine; 3) New Hampshire; 4) north of Boston; 5) south of Boston; and 6) south of Cape Cod.

Take estimates are made for each stratum and then combined over strata to estimate the total annual take. Standard bootstrap techniques were used to calculate the variance and 95% confidence intervals and the resampling unit was defined as a trip. The use of a trip ensures that any within trip dependence in the original data is carried over into the resamples and into the bycatch estimates.

Harbor porpoise have the largest take within this fishery and have been studied the most. Several methods have been developed to obtain comparable and consistent harbor porpoise bycatch estimates within a changing and evolving sampling scheme (Bisack, 1993; Smith *et. al*, 1993; Bravington and Bisack, 1996; Bisack, in press).

Pelagic Drift Gillnet Fishery

The Atlantic pelagic drift gillnet fishery is distributed geographically from the shelf edge region of the Grand Banks off Newfoundland to the Gulf of Mexico. The driftnet is an entanglement net. On average, vessels fish 20 to 22 inch mesh, 60 to 70 meshes deep, and 1.5 miles long. The gear is typically deployed at sunset and suspended below the surface 18 to 30 feet with poly ball floats spaced approximately 125 feet apart. The gear is retrieved in the morning and usually one set is made nightly.

Marine mammal take rates and total effort were estimated from NEFSC's Sea Sampling data and SEFSC's mandatory self-reported fisheries information system for large pelagics, respectively. The unit of effort chosen for these analyses is a set. Most fishing effort is concentrated along the southern edge of Georges Bank in the summer months (mainly June to September), and off Cape Hatteras in the winter (most recently January through March). Based on the examination of the species composition of the catch and the locations of the fishery throughout the year suggested that the driftnet fishery be stratified into two strata, a southern or winter stratum, and a northern or summer stratum.

Estimates of the total bycatch, for each year from 1989 to 1993 were obtained using aggregated (pooled 1990 to 1993) catch rates times the annual effort. Details of these analyses can be found in Northridge (1996). Estimates of total annual bycatch for 1994 and 1995 were estimated from the sum of the observed take and the product of the average take per haul and the number of unobserved hauls as recorded in the logbooks, as shown below.

$$Total\ Take = Total\ Observed\ Take + \frac{Total\ Observed\ Take}{Total\ Observed\ Sets} * Total\ Unobserved\ Sets$$

In 1994 and 1995, 87% and 99% of the sets were observed. Since the observer coverage was high, a finite population correction (fpc) factor was applied (Cochran, 1977). If the fpc were not applied, the variance would be upwardly biased. Standard bootstrap techniques were used to calculate the variance and 95% confidence intervals, and the resampling unit was defined as a set. For more details of these analyses see Bisack (in prep).

Pelagic Pair Trawl Fishery

Pair trawling for tuna or other large pelagics involves the deployment, towing, and retrieval of a large mesh net between two trawlers. The trawl nets used for this fishery are unusual due to their large mesh size (3.2 to 20 meters) and large overall dimensions (300 to 1200 meter circumference). In addition, unlike most trawls, these designs cannot be towed in contact with the seabed. Pair trawlers can sweep a much wider area of the seabed than otter trawlers twice their size. The long warps on either side of the net herds the fish schools into the net without towing through the school of fish. This is probably one of the most significant factors to its success in catching fish. It is a night time fishery with tows typically 3 to 5 hours in duration.

Marine mammal take rates and total effort were estimated from NEFSC's Sea Sampling data and SEFSC's mandatory Pelagic Logbook data, respectively. The unit of effort chosen for these analyses is a set. The fishery is concentrated along the outer shelf in the mid-Atlantic region, especially around Hudson Canyon. The fishing season extends from June through November. Examination of the locations and species composition of the bycatch, showed little seasonal change for the six months of operation and did not warrant any seasonal or areal stratification of this fishery. The calculation of the point estimate, variance and confidence intervals are identical to those explained in the Pelagic Drift Gillnet Fishery for 1994 and 1995.

North Atlantic Bottom Trawl

Otter trawls are the most widely used type of bottom trawl in commercial fisheries, and owe most of their success to the herding action of the trawl doors and sweeplines. A substantial body of research on the behavior of fish in the path of otter trawls (Maine and Sangster 1981, Wardle 1986) has shown that the trawl doors, sweeplines, and mud or sand clouds produce strong auditory and visual stimuli that can actually herd fish or shellfish in the path of the oncoming net. To be effective, the length of the sweeplines, attack angle of the sweeplines, and vessel speed must be carefully "tuned" to the maximum swimming speed of the target species.

The North Atlantic bottom trawl operates in waters of the Gulf of Maine, Georges Bank, and Mid-Atlantic area. The gear is towed on average of 2 hours. The target species in tows where marine mammals have been caught consisted of a mixture of groundfish, monkfish, silver and white hake, and Atlantic long-fin squid.

Marine mammal take rates and total effort were estimated from NEFSC's Sea Sampling data and WO data, respectively. The unit of effort chosen for these analyses is days fished. Days fished is the amount of time the gear is in the water fishing. The fishery was stratified into 4 quarters of the year and 3 large geographic areas. The areas are: 1) the Gulf of Maine; 2) Georges Bank and: 3) the Mid-Atlantic area. Given the extremely low observer coverage (less than 1%), it was not possible to determine whether any of the marine mammal species that were observed taken were correlated with any particular species the gear was targeting at that time and area of capture. Therefore, large geographical strata were chosen. The total take is the product of the take per days fished and total days fished, as shown below.

$$Total\ Take = \frac{Total\ Observed\ Take}{Total\ Observed\ Days\ Fished} * Total\ Days\ Fished$$

Standard bootstrap techniques were used to calculate the variance and 95% confidence intervals and the resampling unit was defined an individual tow.

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Table 1. Marine mammals incidentally taken by commercial fishery, years total take estimates have been made and are reported within this stock assessment report. Only strategic stocks have been included in this table in 1994 and 1995 since assessments were completed.

Common Species Name	New England Multispeicies Sink Gillnet	Pelagic Drift Gillnet	Pelagic Pair Trawl	North Atlantic Bottom Trawl	Mid-Atlantic Coastal Sink Gillnet	Longline
Beaked Whale		91-95				
Bottlenose Dolphin		89-95	91-95	91	94	
Common Dolphin		91-95	92, 93, 95	95	95	
Dwarf Sperm Whale		95				
Harbor Porpoise	90-95	93			95	
Harbor Seals	90-93					
Humpback Whale		91-93, 95				
Minke Whale	91	95				
Pilot Whale		91-95	92-95			93
Right Whale		91-93				
Risso Dolphin		89-93	91-93			92-93
Sperm Whale		91-93				
Spinner Dolphin		89-93				
Spotted Dolphin		89-94				93
Striped Dolphin		89-95		91		
Whitesided Dolphin	91-95	91-93		92, 94		

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